

APPENDIX F-3

Qualitative Analysis Paper

Essential Fish Habitat

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ACRONYMS AND ABBREVIATIONS

ADF&G	Alaska Department of Fish and Game
AFSC	Alaska Fisheries Science Center
BSAI	Bering Sea and Aleutian Islands
CEQ	Council on Environmental Quality
DOI	Department of Interior
EAs	Environmental Assessments
EBS	eastern Bering Sea
EEZ	Economic Exclusion Zone
EISs	Environmental Impact Statements
EFH	essential fish habitat
FMPs	Fishery Management Plans
E.O.	Executive Order
ft	feet
GOA	Gulf of Alaska
HAPC	Habitat Areas of Particular Concern
IFQs	Individual Fishing Quotas
LLP	License Limitation Program
m	meters
MMA	Marine Managed Areas
MPAs	Marine Protected Areas
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
nm ²	square nautical miles
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
NRC	National Research Council
PSC	prohibited species catch
SFA	Sustainable Fisheries Act
SSL	Steller Sea Lion
TAC	Total Allowable Catch
VMS	vessel monitoring system

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Essential Fish Habitat and Marine Protected Areas

1.0 Introduction

Protection of marine habitats including areas defined as essential fish habitat (EFH) is an integral component of the Groundfish Fishery Management Plans (FMPs) for the Bering Sea and Aleutian Islands (BSAI) and Gulf of Alaska (GOA). This section considers the proposed closure areas under the four policy alternatives, and their direct/indirect effects on EFH and other aspects of the biological, physical, social, and economic environments.

Historically, the North Pacific Fishery Management Council (NPFMC) and Alaska Board of Fisheries have adopted, and the National Marine Fisheries Service (NMFS or NOAA [National Oceanic and Atmospheric Administration] Fisheries) has implemented, closures of certain areas to fishing in order to achieve a variety of objectives, all of which provide some level of habitat protection or reduced levels of disturbance. These historical closures, along with other measures such as time/area controlled harvest quotas, bycatch limits and gear restrictions, are legitimate fishery management tools that support designations of EFH and Habitat Areas of Particular Concern (HAPC) (EFH Final Rule: 50 CFR Part 600). HAPCs are habitat types or areas that may require extra protection and are defined using specific considerations (see Section 3.6). In Alaska, HAPC has been specifically defined as living substrate in shallow and deep water, and freshwater areas used by anadromous fish.

One way that impacts to EFH and HAPC can be mitigated is through the designation of Marine Protected Areas (MPAs). In May of 2000, President Clinton signed an Executive Order (E.O.) 13158 “Regarding Marine Protected Areas in the United States.” This order directs the Department of Commerce and Department of the Interior to develop a plan for enhancing existing MPAs and establishing or recommending new MPAs, as appropriate.

MPAs are geographically defined areas designated with special protections to enhance the management of marine resources (ADF&G 2002, NRC 2001 and E.O. 13158). Specifically, MPAs can include the following types of management areas:

- **Marine Reserve (No-Take)** – a general category that prohibits the extraction of all living resources and disturbance or destruction of habitats. This includes critical habitat areas established to protect threatened or endangered species. Included in the Marine Reserves are Ecological Reserves where removal or disturbance of living or non-living marine resources as necessary for monitoring and research to evaluate reserve effectiveness is allowed. Access and recreational activities may be restricted in Marine Reserves to prevent damage to the resources. In the Programmatic SEIS management alternatives, the term “no-take marine reserve” is used to describe this type of closure area as applied to the groundfish fishery. An example from existing management is the Sitka Pinnacles Marine Reserve where all groundfish fishing is prohibited, but commercial and recreational salmon trolling is allowed. If the no-take concept were to be applied more broadly (in this case outside of the groundfish FMPs), consultation within and outside of NOAA Fisheries and the NPFMC would be required along with possible regulatory action.

- **Marine Fishery Reserve** – a closure area where extraction of a specified fishery resource is prohibited. These long-term, but not necessarily permanent closure areas are used to rebuild stocks, provide insurance against overfishing, or enhance fishery yield. Under the current groundfish FMPs, the Bogoslof Groundfish Closure Area could be considered to have the secondary intent of improving the groundfish fishery resources in the area, even though the primary intent of this closure is protection of Steller sea lions (SSLs).
- **Marine Habitat Reserve** – a closure area where habitat disturbance, such as the use of bottom contact fishing gear of specified types, is prohibited. The Programmatic SEIS denotes these areas as “no-trawl MPAs”. Examples from existing management would be the Red King Crab Savings Area and Pribilof Islands Habitat Conservation Areas (see Section 1.2 below). Most of the closures discussed under existing management fall into this category.

Many of the existing closure areas fit one or more of these definitions of an MPA, but have not been specifically defined as MPAs in the existing groundfish FMPs and Amendments.

1.1 Definition of EFH and a Regulatory Overview

In October 1996, the U.S. Congress reauthorized the Magnuson-Stevens Fishery Conservation and Management Act (MSA) through the Sustainable Fisheries Act (SFA). The Final Rule implementing the EFH provisions of the MSA (50 CFR Part 600) was promulgated in January 2002. The intended effect of the rule is to promote the protection, conservation, and enhancement of EFH.

EFH is defined by the MSA as those waters and substrate necessary to manage fish species for spawning, breeding, feeding, or growth to maturity. For Alaska groundfish, this includes the habitat for all target groundfish species, non-target species, prohibited species, other species, and their prey. When viewed in aggregate, across all species, EFH is all pelagic and benthic habitat in the Alaska EEZ. The EFH definitions for all managed species are currently being reviewed by the NPFMC and NOAA Fisheries through its EFH amendment process. A decision on the Alaska EFH definitions will be made by the end of 2004. For purposes of this PSEIS, we therefore provisionally defined EFH generally as all benthic habitat.

The Final Rule also includes provisions requiring Regional Fishery Management Councils (Council) to amend their FMPs to describe and protect EFH and to mitigate any adverse impacts potentially caused by fishing activities. Consistent with these provisions, this analysis focuses on the following question: Do the alternative management policies result in conditions that offer protection to and minimization of adverse impacts to EFH? As explained above, this analysis focuses on benthic EFH, which is generally believed to be at greater risk to the impacts of fishing than non-benthic habitat in the water column. In addition, much of the analysis focuses on the impacts of bottom trawling. It is recognized that fixed gear (longlines, pots, and jigs) or pelagic trawl gear that comes in contact with the sea floor can disturb benthic EFH. In some types of habitat, fixed-gear may cause an impact due to its ability to be more easily fished on rougher substrates (e.g., boulders with coral) than bottom trawl gear. However, most scientific studies of gear impacts have dealt with bottom trawls and dredging because this gear is the most controversial (Auster and Langton 1999, Jennings and Kaiser 1998, Hall 1999b, NRC 2002).

The Final Rule requires that FMP components include mitigation measures for the adverse effects of fishing. Fishery management options may include, but are not limited to fishing equipment restrictions, time area

closures, and harvest limits. At present, environmental and human variables that could affect habitat quality are now addressed in the FMPs for both the BSAI and GOA (NPFMC 1999). However, the EFH environmental assessment (EA) and FMP Amendments 55/55, along with similar actions prepared by five other Councils, were challenged by a coalition of seven environmental groups and two fishermen's associations. The plaintiffs' challenge was twofold. The U.S. District Court for the District of Columbia found that the agency's evaluation of fishing gear impacts on EFH in the FMP amendments was in accordance with the MSA. However, the supporting EAs, failed to comply with the requirements of the National Environmental Policy Act (NEPA) and the regulations promulgated by NPFMC on Environmental Quality (CEQ) and the NOAA. The court determined that the EAs did not consider the full range of relevant alternatives, nor did they fully explain the environmental impact of the proposed action and alternatives. In addition, the EAs failed to address any mitigative efforts to reduce adverse effects from fishing activities.

The Assistant Administrator of NOAA Fisheries determined that the agency would prepare new regional environmental impact statements (EISs) to include all FMPs covered by the EAs. Following are several key areas of guidance provided in his determination:

- The selected range of alternatives should be developed by taking into account comments NOAA Fisheries receives during the scoping process; the EIS must evaluate a reasonable range of alternatives for developing the mandatory EFH provisions of the affected FMPs.
- The analysis should include alternative ways of identifying EFH.
- The analysis should discuss alternative areas or different approaches that could be used to designate HAPCs.
- The alternatives analysis should identify a range of approaches that could be taken to minimize the adverse effects of fishing on EFH. If information is lacking on the effects of specific fishing practices on EFH, the analysis should examine alternatives that could be taken in the face of uncertainty.
- To the extent feasible, NOAA Fisheries should use the NEPA process as the vehicle for reviewing and revising the information contained in the original EFH FMP amendments. Such a review should include information regarding the description and identification of EFH, threats to EFH from fishing and non-fishing activities, and measures that could be taken to minimize those threats.

The proposed action to be addressed in the EFH EIS is the development of the mandatory EFH provisions of all five FMPs of the NPFMC: the Bering Sea and Aleutian Islands Groundfish; GOA Groundfish FMP; Bering Sea/Aleutian Islands King and Tanner Crab FMP; Scallop Fishery off Alaska FMP; and the FMP for the Salmon Fisheries in the Economic Exclusion Zone (EEZ) off the Coast of Alaska. At present NOAA Fisheries and the NPFMC are identifying feasible alternatives for analysis in the EIS for NPFMC's eventual selection of a preferred alternative. The Alaska Groundfish Programmatic SEIS is not intended to replace or supercede the EFH EIS, but will provide overarching policy guidance for EFH and will set the stage for future FMP actions.

1.2 Management Measures Used to Protect Habitat in Alaska

Habitat Protection

Passage of the MSA in 1976 marked the beginning of efforts to integrate habitat considerations into the fishery management process. The MSA directs the Regional Councils to recommend management plans for commercial and recreational harvests of fish in the EEZ. For the most part, the individual states have responsibility for managing fisheries within the territorial sea. Although some early efforts were made to address significant fishery habitat issues, NPFMCs and NOAA Fisheries concentrated largely on ocean harvest during the first decade after passage of the MSA.

In 1983, NOAA Fisheries adopted a National Habitat Conservation Policy, uniting its MSA authority with its advisory responsibilities and authority under the Fish and Wildlife Coordination Act and NEPA. The Habitat Conservation Policy provides guidance to the agency regarding interactions with NPFMCs and with federal and state agencies. It also focuses NOAA Fisheries' habitat conservation efforts on specific habitat impacts potentially affecting fishery resources, marine mammals, and endangered marine species. Although the policy notifies other agencies and NPFMCs of NOAA Fisheries' intent, it does not clarify NPFMCs' role in fishery-related habitat issues.

In 1986, Congress amended the MSA, essentially codifying elements of the NOAA Fisheries Habitat Conservation Policy and giving NPFMCs new authority and responsibility to include “readily available” habitat information in all FMPs. The amendments to the MSA direct NPFMCs, with guidance from NOAA Fisheries, to evaluate fishery practices and assess any practices changing the habitat important to commercial fisheries. Furthermore, the 1986 amendments give NPFMCs the opportunity to recommend habitat management measures for ongoing and proposed federal and/or state activities that could potentially adversely affect fishery resources. Federal agencies are required to respond specifically and substantively to a Council's recommendations within 45 days. The amendments also encourage NPFMCs to monitor state activities and to comment on those activities that could adversely affect Council-managed fishery resources.

In September 1988, the NPFMC adopted a policy to guide the review of habitat issues. In light of this policy, the NPFMC and NOAA Fisheries have enacted certain measures that are consistent with protecting habitat and ecosystem components from potential negative impacts of fisheries. These measures include the use of closed areas to protect habitat. As a result, several areas of the Bering Sea were closed to groundfish trawling and scallop dredging to reduce potential adverse impacts on the habitat for crab and other resources. A chronology of management measures undertaken by the NPFMC with the primary intent or secondary effect of protecting habitat is provided in Table 1. Figure 1 depicts the groundfish closures presently enacted in Alaska's EEZ.

Table 1 Time series of groundfish management measures and closure areas protecting habitat under the BSAI and GOA groundfish FMPs

Year	Location	Season	Area Size	Notes
Bering Sea and Aleutian Islands				
1982 - BSAI groundfish FMP; descriptions of fish habitat, gear restrictions, and several no-trawl zones.				
1983 - NOAA Fisheries adopts a National Habitat Conservation Policy.				
1985 - Intentional discarding of fishing gear and debris prohibited.				
1986 - MSA amended to give Councils authority to protect habitat and recommend habitat protection measures.				
1986 - Habitat policy added to BSAI FMP.				
1987	Area 512	Year-round	8,000 nm ²	Trawling prohibited to protect king crab habitat
	Area 516	3/15-6/15	4,000 nm ²	Trawling prohibited during crab molting period
1995	Chum Salmon Savings Area	8/1-8/31	5,000 nm ²	Re-closed if 42,000 chum salmon bycaught
	Chinook Salmon Savings Area	Trigger	9,000 nm ²	Closed if 48,000 chinook salmon bycaught
	Herring Savings Area	Trigger	30,000 nm ²	Closed to specified trawl fisheries when trigger reached
	Zone 1	Trigger	30,000 nm ²	Closed to specified trawl fisheries when trigger reached
	Zone 2	Trigger	50,000 nm ²	Closed to specified trawl fisheries when trigger reached
	Pribilof Islands	Year-round	7,000 nm ²	Established to protect red king crab habitat
	Red King Crab Savings Area	Year-round	4,000 nm ²	Bottom trawling prohibited by emergency rule, pelagic trawling allowed
	Walrus Islands	5/1-9/30	900 nm ²	12-mile no-fishing zones around 3 haulouts
1995	SSL Rookeries	Year-round	5,800 nm ²	10-mile no-trawl zones around 27 rookeries
	SSL Rookeries	Seasonal ext.	5,100 nm ²	20-mile extensions around 8 rookeries
1996 - same closures in effect as in 1995				
1997 - Red King Crab Savings Area permanently established as year-round closure area				
1997 - same closures in effect as in 1995 and 1996, with two additions:				
1997	Nearshore Bristol Bay	Year-round	19,000 nm ²	Expanded area 512 closure
	Opilio Tanner Crab Bycatch Limitation Zone	Trigger	90,000 nm ²	Closed to specified trawl fisheries when trigger reached
1998 - same closures in effect as in 1995, 1996, and 1997				
1999 - same closures in effect as in 1995, 1996, 1997, and 1998				
2000 - Non-pelagic trawls prohibited in BSAI pollock fisheries.				
2000 - same closures in effect as in 1995, 1996, 1997, and 1998 with three additions:				
2000	EBS and AI Pollock Trawl exclusion zones	Year-round	11,900 nm ² (Inc. GOA)	Trawling for pollock prohibited for SSL protection
	EBS and AI Pollock Trawl exclusion zones	Jan-June	14,800 nm ² (Inc. GOA)	Trawling for pollock prohibited for SSL protection
	EBS and AI Trawl exclusion zones	Year-round	29,000 nm ² (Inc. GOA)	Trawling for Atka Mackerel restricted for SSL protection
2001 same closures in effect as in 1995, 1996, 1997, 1998, 1999, and 2000				
2002 same closures in effect as in 1995, 1996, 1997, 1998, 1999, 2000, and 2001				

Table 1 (Cont.)

Time series of groundfish management measures and closure areas protecting habitat under the BSAI and GOA groundfish FMPs

Year	Location	Season	Area Size	Notes
Gulf of Alaska				
1978 - GOA groundfish FMP; descriptions of fish habitat, gear restrictions, and area closures to foreign fishing.				
1985 - NOAA Fisheries habitat policy added to GOA FMP.				
1987	Kodiak	Year-round	1,000 nm ²	Trawling prohibited; Intended to protect juvenile red king crab habitat
	Kodiak	2/15-6/15	500 nm ²	Trawling prohibited; Intended to protect juvenile red king crab habitat
1990 - Kodiak trawl closures extended				
1993 - Kodiak no-trawl zones made permanent				
1995	SSL Rookeries	Year-round	3,000 nm ²	10-mile no-trawl zones around 14 rookeries
	SSL Rookeries	Seasonal ext.	1,900 nm ²	20-mile no-trawl extensions around 3 rookeries
1996 and 1997 same closures in effect as in 1995				
1998 same closures in effect as in 1995, 1996, and 1997, with one addition:				
1998	Southeast Trawl areas	Year-round	52,600 nm ² (1,929 nm ² on the shelf)	Adopted as part of license limitation program, all trawling prohibited East of 140°
1999 Additional closures to protect SSL critical habitat and:				
1999	Sitka Pinnacles Marine Reserve	Year-round	3.1nm ²	Closure to all commercial gear
2000 same closures in effect as in 1995, 1996, 1997, 1998, and 1999 plus:				
2000	GOA Pollock Trawl exclusion zones	Year-round	11,900 nm ² (Inc. EBS&AI)	SSL protection
	GOA Pollock Trawl exclusion zones	Jan-June	14,800 nm ² (Inc. EBS&AI)	SSL protection
	Cook Inlet Trawl Closure	Year-round	7,000 nm ² (inc. State waters)	Control crab bycatch and protect crab habitat in an area with depressed King and Tanner crab stocks.
2001 same closures in effect as in 1995, 1996, 1997, 1998, 1999, and 2000				
2002 same closures in effect as in 1995, 1996, 1997, 1998, 1999, 2000, and 2001				

Notes: AI - Aleutian Islands
BSAI - Bering Sea/Aleutian Islands
EBS - eastern Bering Sea
FMP - Fishery Management Plan
GOA - Gulf of Alaska
nm² - square nautical miles
SSL - Steller sea lion

Source: NMFS 2001a and Coon *et al.* 1999

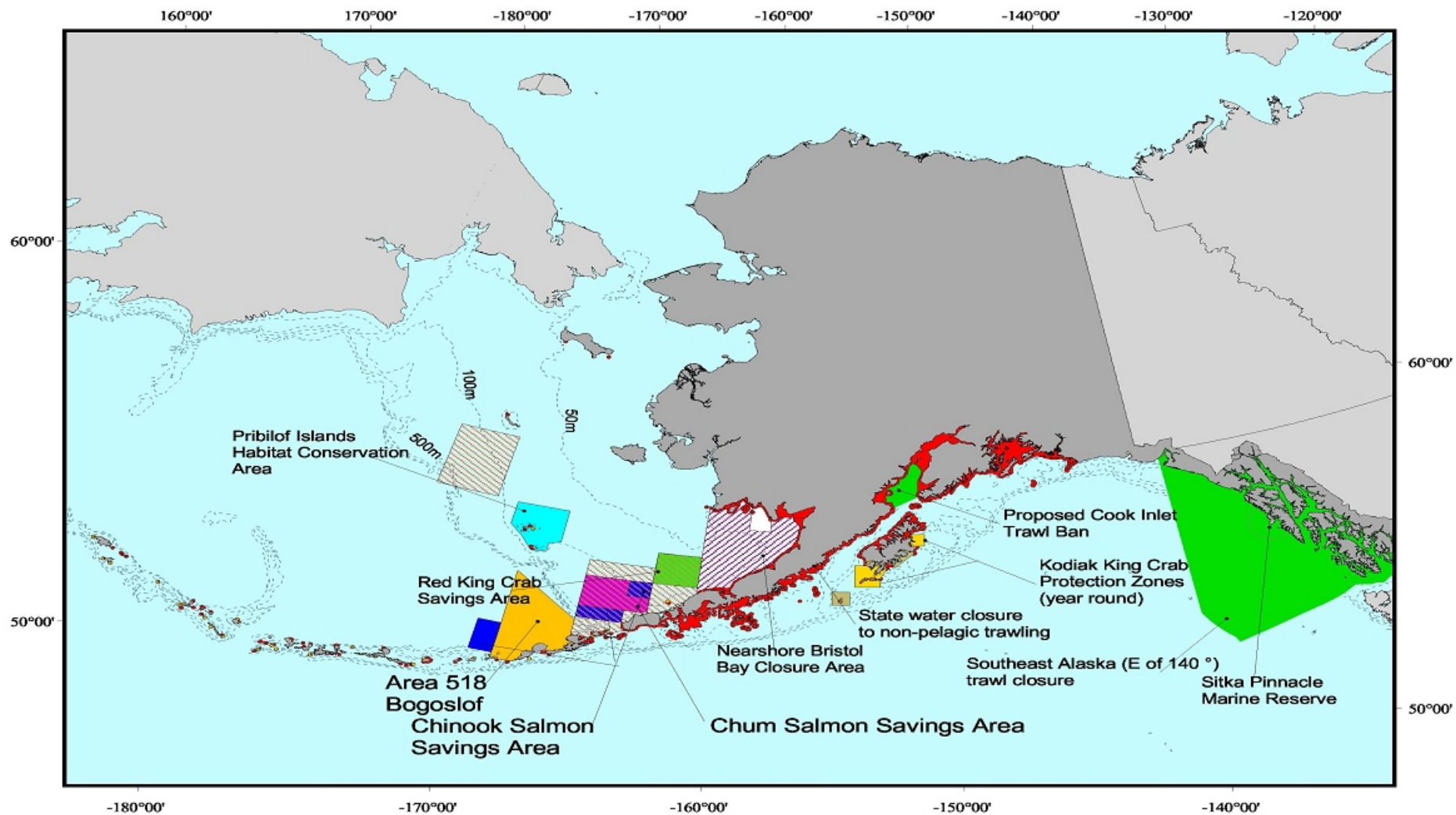


Figure 1. Groundfish closures presently enacted in Alaska's EEZ

Designation of EFH

The 1996 re-authorization of the MSA mandated that NOAA Fisheries and NPFMCs specifically describe and identify EFH within the FMPs. The MSA also required that FMPs minimize, to the extent practicable, adverse effects on EFH caused by fishing. NOAA Fisheries and the NPFMC prepared one EA and a comprehensive set of Habitat Assessment Reports to address the new EFH requirements of the MSA (NPFMC 1999). EFH FMP amendments were submitted to the Secretary in October 1998. The amendments were reviewed and approved by the Secretary of Commerce and took effect on January 20, 1999 (64 CFR 20216). These FMP amendments identified EFH for 80 individual species including target and other fish, and for five species groups incorporating a total of 115 individual species. In cases where information was available, EFH was identified by each particular life stage for a given species (34 of the 80 individual species fell into this category).

According to the Final Rule implementing the EFH provisions of the MSA (50 CFR Part 600), to identify EFH, basic information is needed to understand the usage of various habitats by each managed species. Pertinent information includes the geographic range and habitat requirements by life stage, the distribution and characteristics of those habitats, and current and historic stock size as it affects occurrence in available habitats. Temporal and spatial distribution of each life history stage is necessary to understand each species' relationship to, or dependence on, its various habitats. Data summarizing all environmental and habitat variables that control or limit distribution, abundance, reproduction, growth, survival, and productivity of the managed species should be provided.

Councils must obtain this information to describe and identify EFH from the best available sources, including peer-reviewed literature, unpublished scientific reports, data files of government resource agencies, fisheries landing reports, and other reliable sources. The scientific rigor of the reports and species-specific data gaps and potential deficits in data quality should be taken into consideration.

To analyze habitat information, the EFH Final Rule specifies the following for organizing the data necessary to describe and identify EFH:

- **Level 1:** Distribution data are available for some or all portions of the geographic range of the species. Distribution data may be derived from presence/absence sampling and/or may include opportunistically collected information on species and life stages. In the event that distribution data are available for only portions of the geographic area occupied by a particular life history stage of a species, habitat use can be inferred on the basis of distributions among habitats where the species has been found and on anecdotal information about its habitat requirements and behavior. Habitat use may also be inferred from information on a similar species or another life stage.
- **Level 2:** Habitat-related densities of the species are available. At this level, quantitative data (i.e., density or relative abundance) are available for the habitats occupied by a species or life history stage. Because the efficiency of sampling methods is often affected by habitat characteristics, strict quality assurance criteria should be used to ensure that density estimates are comparable among methods and habitats. Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of habitat value. When assessing habitat value on the basis of fish densities in this manner, temporal changes in habitat availability and utilization should be considered.

- **Level 3:** Growth, reproduction, or survival rates within habitats are available. At this level, data are available on habitat-related growth, reproduction, and/or survival by life history stage. The habitats contributing the most to productivity should be those that support the highest growth, reproduction, and survival of the species (or life history stage).
- **Level 4:** Production rates by habitat are available. At this level, data are available that directly relate the production rates of a species or life history stage to habitat type, quantity, quality, and location. Essential habitats are those necessary to maintain fish production, consistent with a sustainable fishery and the managed species' contribution to a healthy ecosystem.

Councils should strive to obtain data sufficient to describe habitat at the highest level of detail (i.e., Level 4). If there is no information on a given species or life stage, and habitat use cannot be inferred from other means, EFH should not be designated.

The NPFMC (1999) identified EFH information levels for groundfish, crab, scallops, and salmon in the Alaska region. Level 2 data is available for some adult life history stages of groundfish, crabs, and shellfish. Level 2 data is also available for some stocks of red and blue king crab, and tanner and snow crab stocks in some regions, at the egg, larval, late juvenile, and adult stages. The remainder of the data for all other crab stocks is either at Level 1 or unknown. Level 1 data is available for the eggs, larvae, early juvenile, and late juvenile stages of pollock, and for the late juvenile stages of most other groundfish species. Even minimal (Level 1) data are not available for forage fish at all life stages, so distribution and habitat use are considered to be unknown. Salmon EFH data are highly variable and cross Levels 1 through 4 depending on species, stock, and life stage. The majority of the data available for adults in the freshwater stage ranges from Levels 1 to 3. The information levels for all EFH are continually being refined and updated and will be presented in the EIS currently being developed for EFH.

1.3 Potential Impacts of Fishing on Marine Habitat

It is important to distinguish between the direct and indirect effects of trawling and dredging on marine habitat (NRC 2002). Direct and immediate effects of fishing gear potentially include the following:

- Mortality either as intended catch or bycatch or incidental by killing benthic and demersal species or increasing their vulnerability to predators;
- Increased food availability for scavengers due to discarded fish, fish offal, and dead benthic organisms; and
- Loss of habitat due to scraping and plowing, thereby destroying seafloor habitat.

Indirect effects are removed in space and/or time from the actual fishing activity. These effects include post-fishing mortality and reductions in total biomass of target fish. The reductions in biomass could subsequently affect predators, prey, competitors of the targeted species, and the overall benthic community structure. Indirect effects also could be realized at the ecosystem level due to potential changes in energy flow and shifts in the processes of primary production, primary consumption, and secondary production (NRC 2002). An assessment of the potential effects (encompassing both direct and indirect effects) must include the following information.

- Effects of different types of fishing gear on different types of habitat;
- Frequency and geographic distribution of fishing effort; and
- Physical and biological characteristics of the seafloor in the areas being fished.

Effects of Fishing Gear on Habitat

Types of potential effects from fishing gear on habitat are outlined below.

- Alteration of the physical structure;
- Direct mortality of benthic organisms;
- Sediment suspension;
- Chemical modifications to the water column;
- Benthic community changes; and
- Ecosystem changes.

Alteration of Physical Structure

Physical effects of fishing gear such as plowing, smoothing of sand ripples, removal of stones, and turning of boulders can act to reduce the heterogeneity of the sediment surface. Boulder piles, crevices, and sand ripples can provide fish and invertebrates hiding areas and a respite from the need to swim against currents (Rose in prep.). Removal or alteration of these features and of taxa such as worm tubes, corals, and gorgonians that provide relief, and the removal or shredding of submerged vegetation, can also occur, thereby reducing structures available to biota as habitat (see NMFS 2002, Kaiser *et al.* 1998, Lindebloom and de Groot 1998, Auster and Langton 1999).

Any type of fishing gear that is towed, dragged, or dropped on the seabed will disturb the sediment and the resident community to varying degrees. The intensity of disturbance is dependent on the type of gear, sediment type, and frequency of disturbance. See Section 3.6 for a detailed description of different types of fishing gears and their relative disturbance. Heavy gears such as the shellfish dredge and the flatfish beam trawl disturb the seabed intensely. Lighter gears, such as the otter trawl, predominately used in Alaska, also cause disturbance mostly due to the trawl doors and foot ropes which can leave tracks or trenches up to several meters wide and can remove or displace boulders (Hall 1999). There are no studies of fishing gear effects that use gear that is directly comparable to Alaskan pelagic trawls. By regulation, these trawls must not use bobbins or other protective devices, so the footropes are small in diameter, and typically consist of bare chain. Pelagic trawls are fished with the doors above the seafloor, so door effects are not realized. Because the footrope is unprotected, these trawls are not used on rough or hard substrates and therefore do not contact some of the most vulnerable habitats (Rose in prep.).

A number of papers describe trawl marks on substrate, including Gilkinson *et al.* (1998), who describe the scouring process in detail as part of a model door study. It is not known if the trenches might compensate for the sediment smoothing actions of other gears (NMFS 2002). The actions of roller gear trawls can replace natural sediment structures (hummocks, biogenic features, and sand ripples) with other, anthropogenic structures (door, footrope, and roller tracks). In habitats with an abundance of such natural structures, this can represent a decrease in habitat complexity, while in naturally smooth areas, an increase in complexity would be apparent.

Very little information exists regarding the effects of longlining on benthic habitat (see Section 3.6). Rose (in prep.) postulates that due to the very light weight of the lines used with longline gear, effects on substrate and benthic organisms would be limited to the impact of anchors and weights. These make up less than 1/500th of the total length of the gear, so effects on the soft bottoms should be very small. However, effects in hard bottom areas could be realized through snagging on smaller boulder piles and other emergent structures. In a report presented by NPFMC (1992), the authors determined that setline gear often lies slack and can meander for a considerable distance along the bottom. During the retrieval process, the line sweeps the bottom for considerable distances before ascending. It snags on objects in its path, including rocks and corals. Invertebrates and other lightweight objects are dislodged and pass over or under the line. If a line becomes hung or breaks during the retrieval process, the other end, which also has a float, can be used to complete the gear retrieval.

Although little research has been conducted to document the impacts to physical structure from pot gear, it is likely that benthic structures (both living and non-living) could be impacted as the pots are dropped or dragged along the bottom (see Section 3.6). Eno *et al.* (2001) observed that impacted sea pens were able to recover within 72 to 144 hours of the pots being removed. The study concluded that the use of pots and traps has no lasting effects on three different habitat types. However, this study used gear much smaller and lighter than that used in Alaska waters, so the results are not directly applicable. Alaska pots have mesh bottoms that are suspended 2.5 to 5 centimeter above the weight rails that initially contact the substrate (Rose in prep.). The greater weight of the pots is concentrated in a smaller area beneath the pot. Also of concern is the incidence of bottom disturbance by the weight rails as the pot is dragged across the seafloor by bad weather, currents, or during hauling. Rose (in prep.) assumes that the average pressure applied to the seafloor along the rails would be sufficient to penetrate into most substrates during lateral movement. This effect was speculated to be most similar to the effects of pelagic trawls. However, effects could be minimized by pot longline fishermen who retrieve gear by holding the vessel in deeper waters. This allows the gear and pot to be pulled up off the bottom and then be suspended pelagically until the completed set is brought aboard, thereby somewhat reducing bottom effects.

Direct Mortality of Benthic Organisms

In addition to effects on the physical habitat, trawling can cause direct mortality to emergent epifauna. In particular, erect, foliose fauna (fauna which build reef-like structures) can be destroyed by towed gear, longlines, or pots (Hall 1999). Within the trawl track, which could range up to several meters wide, epifauna such as sponges, corals, or gorgonians are often removed, crushed, or broken (Van Dolah *et al.* 1987). Large coral colonies may be hundreds of years old (Risk *et al.* 1998). The habitat created by these gorgonians may be occupied by communities with high biodiversity and may provide shelter for fish (Risk *et al.* 1998, Fossa *et al.* 1999). Given their size and longevity, gorgonian corals may be especially vulnerable to fishing impacts and may take over 100 years to recover (Andrews *et al.* 2002). Although scientists have a limited understanding of its importance as fish habitat, deep water coral clearly provides vertical structure for fish to use for protection and cover. This has been observed in Alaska during submersible dives (Krieger and Wing 2002).

Freese *et al.* (1999) found during experimental trawling studies in the GOA that no motile invertebrates showed reductions in density as a result of trawling. The researchers also note that apparent damage to echinoids, holothurians, molluscs, and arthropods was < 1 percent. However, the authors observed that sponges and sea whips are especially vulnerable to trawl damage, and extensive trawling over wide areas

could impact spatial patterns of invertebrate diversity. More detailed information regarding impacts of trawling on marine benthic organisms is provided in Section 3.6.

Sediment Suspension

Resuspension of sediment can occur as fishing gear is pulled along or immediately above the seafloor (NMFS 2002). The chronic suspension of sediments and resulting turbidity can affect aquatic habitat by reducing available light for photosynthesis, burying benthic biota, smothering spawning areas, and causing negative effects on feeding and metabolic rates. If occurring over large areas, resuspension can redistribute sediments having implications for nutrient budgets by burying fresh organic matter and exposing deeper anaerobic sediments (Messieh *et al.* 1991, Black and Parry 1994, Mayer *et al.* 1991, and Pilskaln *et al.* 1998). The effects may be more pronounced in shallower water.

Species' reaction to turbidity depends on life history characteristics of the organism. Effects are likely to be more significant in waters that are normally clear as compared with areas that typically experience high naturally induced turbidity (Kaiser 2000). Motile organisms can move out of the affected area and quickly return once the turbidity dissipates (Coen 1995). Even if species experience high mortality within the affected area, those with high levels of recruitment or high mobility can re-populate the affected area quickly. Sessile or slow-moving species would likely be buried and could experience high mortality. If effects are protracted and occur over a large area relative to undisturbed area, recovery through recruitment or immigration may be hampered. Furthermore, chronic resuspension of sediments may lead to shifts in species composition by favoring those species that are better suited to recover or those that can take advantage of the additional nutrient supply as the nutrients are released from the seafloor to the euphotic zone (Churchill 1989).

Chemical Modifications to the Water Column

Disturbance due to fishing gear can cause changes in the chemical composition of the water column overlying impacted sediments. In shallow water, the impacts may not be noticeable relative to mixing effects caused by tidal and storm surges, and wave action. However, in deeper, calmer areas with more stable waters, the changes in chemistry may be evident (Rumohr 1998). Increases in ammonia content and decreases in oxygen have been observed in the North Sea waters, along with pulses of phosphate. Although these changes have been documented, it is not clear how they affect fish populations. Increased incidence of phytoplankton blooms could occur during seasons when nutrients are typically low. The increase in primary production could have a positive effect on zooplankton communities and on organisms up the food chain. Eutrophication, often considered to be a negative effect, could also occur. However, it is important to note that these releases of nutrients to the water act to recycle existing nutrients and thereby make them available to benthic organisms rather than add new nutrients to the system (ICES 1992). The recycling is thought to be less influential in the eutrophication process than the input of new nutrients from rivers and land runoff.

Changes to the Benthic Community and Ecosystem

Benthic community structure can be impacted due to direct mortality of benthic organisms, potentially causing a shift in the community from low-productive, long-lived species (k-selected species) to highly productive, short-lived, rapidly colonizing species (r-selected species). Motile species that exhibit high

fecundity and rapid generation times will recover more quickly from trawl-induced disturbance than non-mobile slow-growing organisms, leading to a potential community shift in chronically trawled areas (Levin 1984, NMFS 2002).

The physical structure of the biota also determines their ability to withstand and recover from the physical impacts of fishing gear. For example, thinner shelled bivalves and sea stars often suffer higher damage than solid shelled bivalves (Rumohr and Krost 1991). Animals that can retract below the penetration depth of the fishing gear and those that are more elastic and can bend upon contact with the gear also fare much better than those that are hard and inflexible (Eno *et al.* 2001). In chronically trawled areas, a switch in dominant species based on these avoidance and survival traits could be evident.

Increased fishing pressure in a given area can also lead to changes in species distribution; changes could be evident in benthic, demersal, and even pelagic species (i.e., localized depletion). Specifically, McConnaughey *et al.* (2000) examined the effects of chronic trawling on soft-bottom benthos of the eastern Bering Sea (EBS). They found that overall species diversity and niche breadth of sedentary taxa were greater in unfished areas. The authors have also speculated that mobile fishing may lead to increased populations of opportunistic feeders in chronically trawled areas.

Frequency and Distribution of Fishing Effort

The continental shelf and slope region off the coast of Alaska comprises one of the most extensive fishing grounds in the world (NRC 2002). Bottom trawling in the Bering Sea began in 1929 with a Japanese operation and continued through the 1930s and early 1940s, recommencing in the 1950s after WWII. Soviet and other distant water trawl fishing operations intensely fished the Bering Sea and GOA through the 1960s and 1970s. Domestic bottom trawling began as joint ventures in the Bering Sea in 1978 after passage of the MSA in 1976. These U.S. trawl activities grew rapidly during the 1980s and had displaced foreign fishing by the end of the 1980s. Presently the groundfish fleet is divided into catcher vessels and catcher processors. In 1999, the catch was almost equally divided between the two sectors (NMFS 2001a).

Non-pelagic trawling (bottom trawling) in the Bering Sea during the early 1990s was most intense on the slope and shelf area north of the Aleutian Islands (NRC 2002). The Alaska peninsula in the area of Unimak Island, east of the Pribilofs west of Bristol Bay and off of Cape Constantine were also heavily fished. Virtually all areas of the Bering Sea have experienced some degree of exposure to bottom trawls (see Section 3.6). However, the intensity of exposure, measured in trawls made per unit area, varies substantially. These patterns reflect the nonrandom behavior of fishing fleets, which is based on historical patterns of performance and regulatory restrictions. Relatively heavy trawling has occurred in three places: along the shelf edge, along the Alaska Peninsula near Unimak Island, and in Togiak Bay. The primary composition of the catch in these three areas, respectively, is 1) pollock, Pacific cod and Greenland turbot, 2) Pacific cod and pollock, and 3) yellowfin sole (Fritz *et al.* 1998).

However, large areas of the Bering Sea presently have no trawling activity because of closed management areas, less productive fishing grounds, or unobserved tows. Both the spatial extent and intensity of fishing effort decreased in the 1990s. Over large parts of the Bering Sea there were either no observed bottom trawls or only about four tows averaged over two years (NRC 2002). There were significant reductions in the geographic extent and intensity of trawling the GOA also. The number of tows in the region was reduced by about half due to management area closures and general reductions in fishing effort associated with fisheries

management. The area experiences a relatively low intensity of trawling as compared with other regions of the United States (NRC 2002). Section 3.6 provides additional discussion on the frequency of trawling in the Bering Sea and GOA.

The relative significance of seabed disturbance by mobile and other fishing gear must be considered in light of the magnitude and frequency of seabed disturbance due to natural causes. De Alteris *et al.* (1999) found that in a shallow, sand substrate where natural processes are disturbing the seabed regularly, recovery of the substrate from gear-related disturbance was almost immediate. However, in deep, mud substrates the analyses indicated that natural processes are rarely capable of disturbing the seabed; therefore, recovery from gear-related disturbance was slow. Many studies summarized by NRC (2002) and NMFS (2002) indicate that more stable, biogenic, gravel and mud habitats experience the greatest impacts from trawling and have the slowest recovery rates. By comparison, those areas with less consolidated, coarse sediments that also typically experience high rates of natural disturbance, show fewer impacts. These habitats tend to be populated by opportunistic species that recolonize the area rapidly, thereby reducing recovery times. Section 3.6 provides additional discussion of the relative impacts of fishing on different habitats.

Physical and Biological Characteristics of the Seafloor

Most bottom fishing off the coast of Alaska takes place on the continental shelf and upper slope in water depths of less than 500 meters (m). The seafloor affected, or potentially affected, covers a wide range of habitats, from relatively featureless sand and mud to more complex rocky areas and HAPCs. As discussed previously under Alteration of Physical Structure, hard substrates and rocky areas provide the most habitat complexity for the benthic community and are likely to be more vulnerable to fishing disturbance.

Four habitat types in the Bering Sea shelf were defined by Rose (in prep.) using habitat sediment data in Smith and McConnaughey (1999). Figure 2 depicts these habitat strata. The first, situated around the shallow eastern and southern perimeter of the shelf and near the Pribilof Islands, consists of sand substrates with a small amount of gravel. The second lies across the central shelf out to the 500-m contour and is composed of mixtures of sand and mud. A third strata, west of a line between St. Matthew and St. Lawrence Islands, is composed primarily of mud (silt) substrates with some sand. The fourth strata, found north and east of St. Lawrence Island including Norton Sound, consists of a complex mixture of substrates that are not easily separated out or defined; however, these areas are subject to very little fishing effort.

A similar comprehensive substrate data set does not exist for the GOA and Aleutian Islands. Both of these areas have complicated substrates with mixtures of hard (pebbles, cobbles, boulders, and rock) and soft (silt, sand, and gravel) substrates, but data are not sufficient to describe the spatial distributions of these substrates. However, data collected from NOAA Fisheries groundfish surveys regarding "trawlability" were compiled to approximate percentages of hard substrate in the following depth strata (Rose, in prep.).

- Shallow waters (1-100 m) - 19 percent hard substrate;
- Deeper areas on the shelf (gullies; 100-300 m) - 5 percent hard substrate; and
- Upper slope (200-500 m) - 10 percent hard substrate.

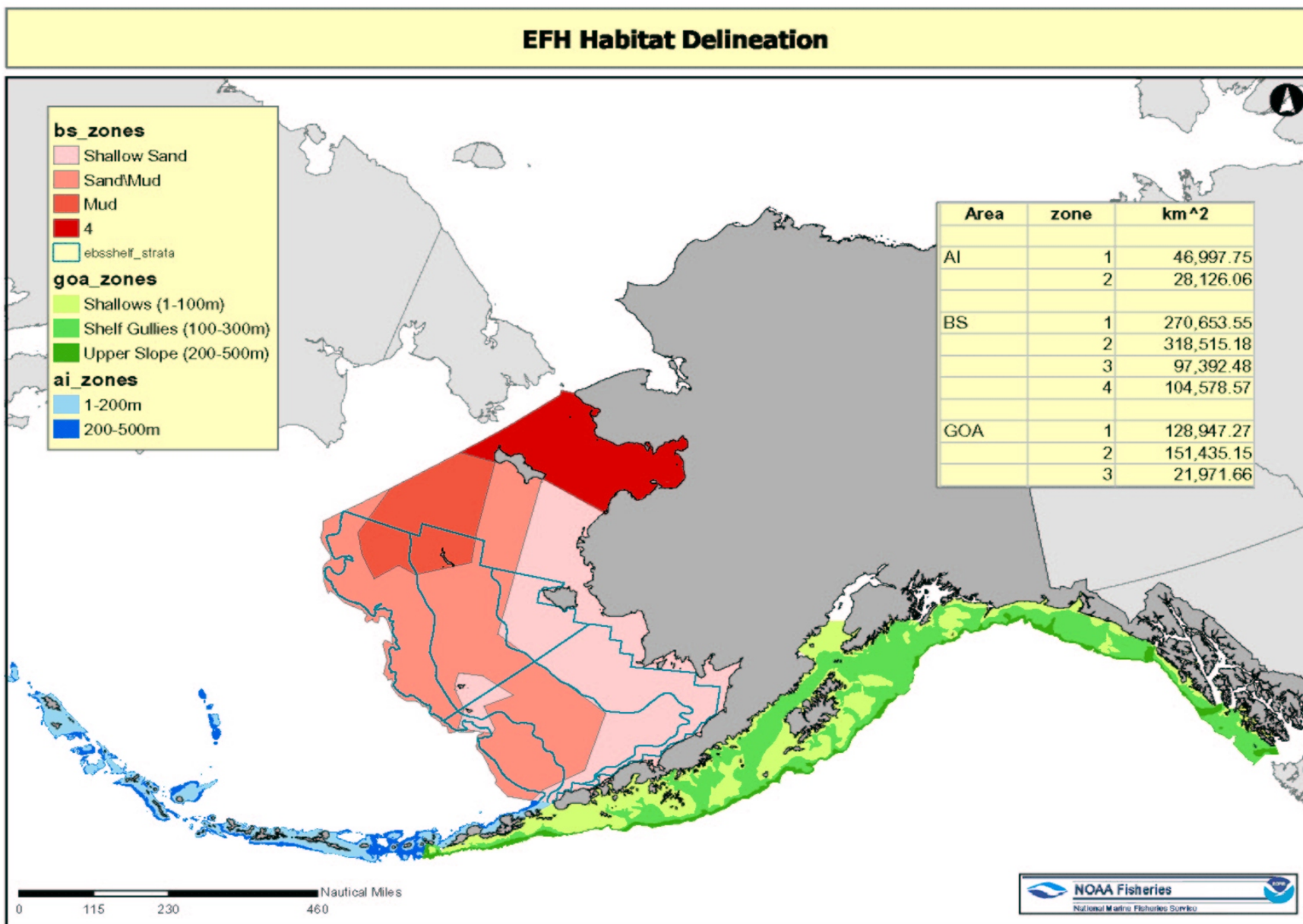


Figure 2. EFH habitat delineation

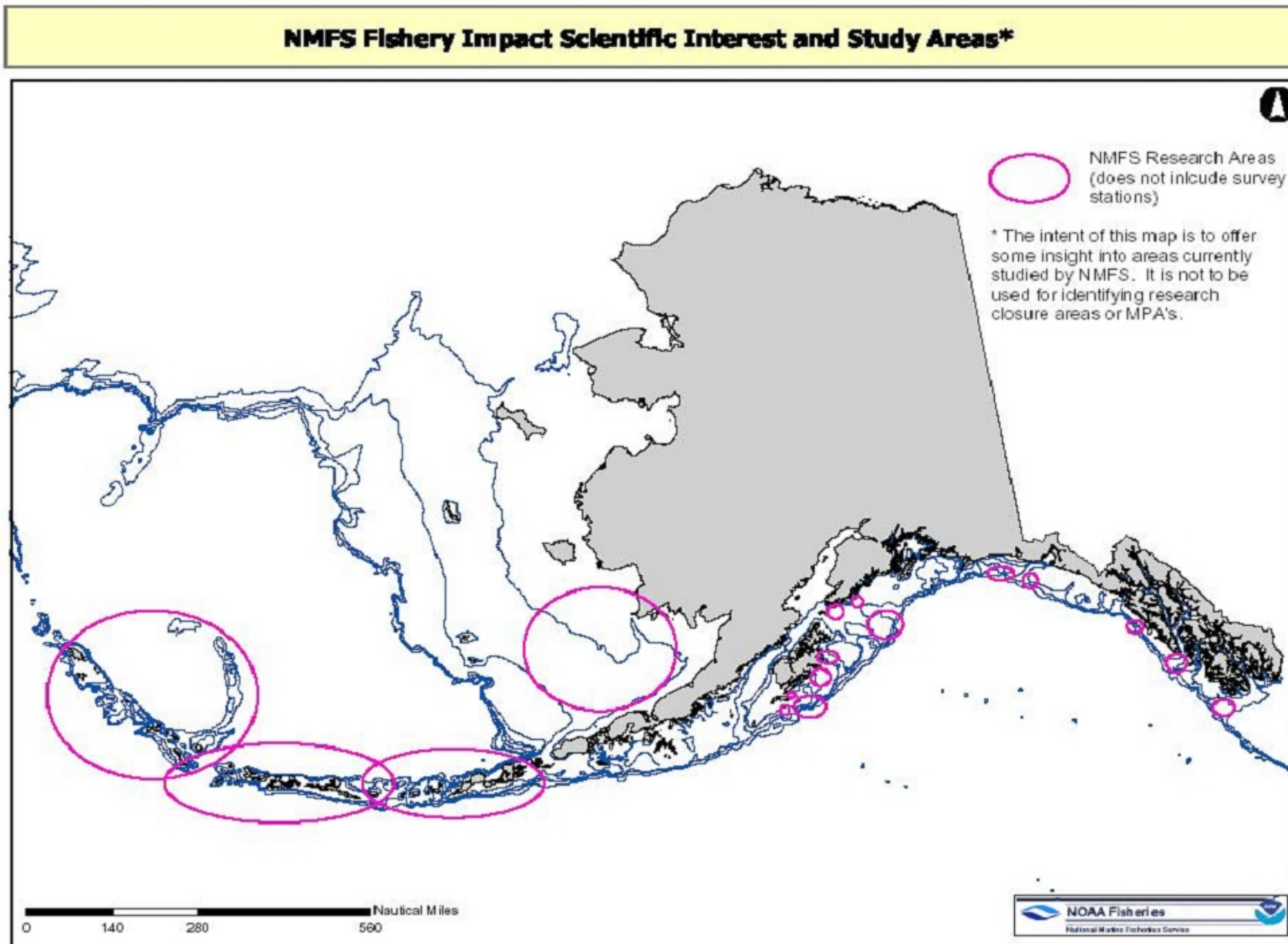


Figure 3. NMFS fishery impact scientific interest and study areas.

These areas are also depicted on Figure 2. As presented below, the percentages of hard bottom substrate as derived from “trawlability” data are limited in interpretation.

- A standard trawl may function well on hard substrate consisting of smoother pebbles and cobbles;
- Trawlable bottom may be found in areas of mostly hard substrate; and
- Patches of soft bottom may exist in otherwise untrawlable areas.

As described above, there is a considerable lack of scientific information on benthic habitats found in the EEZ. Thus, NOAA Fisheries through the Alaska Fisheries Science Center (AFSC) is presently conducting research to map limited areas of the Alaska EEZ for geographic characterization. In 2000, 900 square kilometers of seafloor near Kodiak were mapped and during July 2002 an additional 500 square kilometers near Yakutat were mapped using a high-resolution multibeam echo-sounder. Survey depths ranged from 100 m to 760 m and the seafloor consisted of irregular seabed with mixed sediments (sand, mud, gravel) and high-relief areas consisting of boulders. As it is completed, the mapping of the area will allow habitat characterization to be compared to fishing intensity for analysis of impacts. Figure 3 depicts scientific interest and research areas presently being studied by NOAA Fisheries.

1.4 Recommendations for Establishing MPAs in Alaska

In order to comply with the requirements of E.O. 13158 mandating the establishment of MPAs, NOAA, in conjunction with the Department of Interior (DOI) and other partners, has created the MPA Center (see <http://www.mpa.gov>). E.O. 13158 defines an MPA as “any area of the marine environment that has been reserved by federal, state, territorial, tribal or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein.” Moreover, it defines “marine environment” to mean “those areas of coastal and ocean waters, the Great Lakes and their connecting waters, and submerged lands there under, over which the United States exercises jurisdiction, consistent with international law.”

Given the breadth of this definition and the wide array of potential sites it includes, the MPA Center has developed operational criteria to interpret the definition consistently and to decide whether to consider specific sites or entire classes of sites for inclusion in the official inventory. According to the MPA Center, to be included in the MPA List the site must meet the following criteria:

- Have defined geographical boundaries or a definable geographic location and, a) may or may not be associated with the underlying seabed and b) may be of any size, but must be a subset of the U.S. federal, state, territorial, local or tribal waters;
- Encompass: a) areas of the oceans, coastal waters, bays and/or estuaries; or b) the Great Lakes and their connecting waters;
- Have a marine component which may include an intertidal area and may have an associated land (terrestrial) component;
- Be authorized by some form of federal, state, territorial, local or tribal law, or regulations;
- Provide year-round (12 months) protection;

- Be established with an expectation of, or at least the potential for, permanence. Areas with a sunset clause must provide a minimum of four years of continuous protection and must have a specific mechanism to renew protection at the expiration of the sunset period; and
- Have existing laws/regulations that apply to the MPA and that were designed to afford increased protection to part or all of the natural and cultural resources therein, beyond any general protections which apply outside the MPA.

Specifically, the MPA Center's working definition excludes sites that fit in the following categories:

- Areas of the U.S. EEZ that are covered under legal authorities but have no distinct boundaries with specific authorities for resource protection;
- Areas subject to generic resource management authorities linked to habitat type but without specific locations;
- Areas subject to species-specific conservation authorities that are not focused on a definable geographic area;
- Strictly freshwater areas outside the Great Lakes that contain marine species at certain seasons or life history stages;
- Privately created and maintained marine areas;
- Areas subject to emergency measures designated for fisheries or other purposes;
- Mitigation sites and other temporarily closed areas;
- Areas set aside to avoid fishing gear conflicts;
- Areas subject to single species management measures that do not have demonstrable benefits to a broader array of species or habitats; and
- Areas subject to fisheries quota management tools.

Taken together, these criteria provide the basis for the MPA List Site Working Definition. The MPA Center will coordinate the implementation of the E.O. by developing “a framework for a national system of MPAs, and Federal, State, territorial, tribal, and local governments with the information, technologies, and strategies to support the system.”

The Departments of Commerce and the Interior are the implementing agencies for developing the MPA List. A five-step process is proposed to determine which sites should be added to the official MPA List. While this process is still under agency review, it is presented here to illustrate the process that has been followed to date:

1. The implementing agencies, working collaboratively with federal, territorial, state, local, and tribal partners, identify potential sites for consideration as marine managed areas and MPA List Sites.
2. Basic information about the sites is gathered by the implementing agencies (see Initial Data Fields Available from the Inventory at <http://www.mpa.gov>) and is compiled in the Marine Managed Areas (MMA) Inventory.
3. A review panel of the implementing agencies considers each site in the MMA Inventory to determine if it meets the criteria for an MPA List Site. Those sites that meet all criteria will be forwarded for approval by the Secretaries of Commerce and the Interior or their designates. Those that do not will remain in the inventory database.
4. Sites approved by the Secretaries or their designates will be entered on the official MPA List.
5. The implementing agencies will initiate an expanded data collection effort for sites on the MPA List.

Additionally, the EFH Final Rule (50 CFR Part 600) offers options to manage adverse effects from fishing. One of these options is time and areas closures. Actions related to time and area closures may include designating zones or use as MPAs to limit adverse effects of fishing practices on vulnerable or rare areas, species, or EFH life stages, such as those areas designated as HAPCs.

The Final Rule also requires FMPs to identify specific types or areas of habitat within EFH as HAPC based on one or more of the following considerations. In designating MPAs, these HAPC considerations should also be addressed:

- Importance of ecological function provided by the habitat;
- Extent to which the habitat is sensitive to human-induced environmental degradation;
- Whether, and to what extent, development activities are, or will be, stressing the habitat type; and
- The rarity of the habitat type.

Similarly, the National Research Council recommends that the task of designating MPAs follow four sequential steps (NRC 2001):

1. Evaluate conservation needs at both local and regional levels;
2. Define the objectives and goals for establishing MPAs;
3. Describe key biological and oceanic features of the region; and
4. Identify and choose sites(s) that have the highest potential for implementation.

In Alaska, the Alaska Department of Fish and Game (ADF&G) is taking the initiative to develop a public process for establishing MPAs (ADF&G 2002). The ADF&G recommendations focus on closing areas to fishing. Despite this focus on fishing, the department recognizes a larger context and need for MPAs. Multiple objectives are to be considered: protection for marine life, protection from pollution, protection from adverse impacts of mineral extraction, protection of culturally important sites, and maintenance of pristine ecosystem structure and function. The recommendations contend that these issues must also be considered when evaluating MPAs that are initially proposed for fishery management purposes. While both the National Research Council and ADF&G focus on the designation of MPAs as tools to improve fishery

management, both also recognize that there are other reasons for establishing MPAs (ADF&G 2002, and NRC 2001):

- Conserve biodiversity;
- Protect ecosystem integrity and sensitive habitats from disturbance;
- Preserve cultural heritage; and
- Provide educational and recreation opportunities and establish sites for scientific research.

Taking into consideration the criteria, considerations, steps, and processes described above, specific actions to achieve the objectives for MPA establishment have been recommended by ADF&G:

- Adopting a policy for establishing MPAs with due considerations to realistic time frames and staff commitments;
- Establishing a public involvement process to involve stakeholders at the earliest reasonable opportunity;
- Conducting a needs analysis for reserves and habitat protection;
- Selecting reserve sites through an objective and transparent process so that stakeholders are included and decisions are well-justified. Identified sensitive marine habitats and use of experimental control areas should be considered and possibly receive priority for designation;
- Establishing buffer zones around reserves to help meet reserve objectives. For example, a no-take zone may be established with a larger MPA having seasonal gear or individual species closures;
- Facilitating coordination among federal and state agencies;
- Developing a management plan for designated reserves; and
- Monitoring and evaluating reserve effectiveness.

FMP 3.1 directs that a methodology for developing MPA designation criteria be developed. Therefore, a methodology incorporating aspects of these papers is provided later in this section.

1.5 Non-Consumptive Factors Associated with Establishing MPAs

The above discussion provides recommendations and a process for the designation of marine reserves and protected areas as tools in fisheries management, particularly as applied to the identification and protection of EFH and HAPCs. However, there are other, equally important values associated with MPAs including recreation, tourism, education, and scientific inquiry.

The marine environment provides people with a range of benefits, even if marine resources are not specifically exploited from a given area (NRC 2001). Direct, on-site values are typically associated with consumptive uses (commercial and sport fisheries, shell and sponge collecting, resource extraction from the sea bed, etc.); however, non-consumptive uses such as tourism, diving, bird and whale watching, and the

general aesthetics of wild areas can also be considered valuable to humans. Consumptive activities are more easily quantified since they usually provide income directly to participants and indirectly to coastal economies that service the activities. Non-consumptive uses related to tourism, diving and bird watching, and education can have measurable economic benefits as industries supporting these users are developed.

Less easily quantified are the heritage or existence values associated with the public's appreciation of unique and natural systems (NRC 2001). Also difficult if not impossible to adequately quantify are any potential or perceived benefits of MPAs to components of regional and global climatological, biological, and chemical systems.

Establishment of MPAs will directly curtail consumptive use such as fishing and other resource extraction. The potential increase in non-consumptive uses such as tourism and education, which can often have positive economic outcomes, may serve to balance any resulting economic disadvantages. However, due to the remoteness of Alaska and the likelihood that MPAs may be located in offshore/deep waters, economic gain from non-consumptive uses may be limited.

2.0 Alternative Analysis

There are four policy alternatives under consideration by NPFMC:

Alternative 1 – Continue Management Under Existing (Updated) Policy: Under this alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. This policy assumes that fishing does result in some adverse impacts to the environment and that, as these impacts become known, mitigation measures will be developed and appropriate FMP amendments will be implemented. Under this policy statement, specific goals to reduce and avoid impacts to habitat include responding to new scientific information regarding areas of critical habitat by closing those regions to all fishing; evaluating the impacts of trawl gear on habitat through the stepwise implementation of a comprehensive research plan to determine appropriate habitat protection measures; and continuing to evaluate candidate areas for MPAs as stipulated by E.O. 13158.

Alternative 2 – Adopt a More Aggressive Harvest Strategy: A more aggressive harvest policy would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. This policy assumes that fishing at the recommended levels would have no adverse impact on the environment, except in specific cases that are generally known. Under this alternative, the evaluation of trawl gear impacts on habitat would continue through the implementation of the existing research plan. The identification of EFH, determination of appropriate habitat protection measures, and evaluation of candidate areas for marine protected areas (E.O. 13158) would also continue, but certain areas presently closed to fishing in order to protect habitat could be considered open to fishing.

Alternative 3 – Adopt a More Precautionary Management Policy: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management and ecosystem-based management principles, and, where appropriate and practicable, to increase habitat protection and impose additional bycatch constraints. Under this approach, additional conservation management measures would be taken as necessary to respond to social, economic, or conservation needs. Additional measures would be taken if scientific evidence indicated that the fishery was negatively impacting

the “environment” not just a population of a given species. Specifically, Alternative 3 seeks to reduce and avoid impacts to habitat by developing goals, objectives, and criteria to evaluate the efficacy of MPAs and no-take marine reserves as tools to maintain abundance, diversity, and productivity of marine organisms. This could be done by considering implementation of MPAs and, where appropriate, giving due consideration to areas already closed to various types of fishing operations. In addition, the policy would develop a research program to identify regional baseline habitat information and mapping, evaluate the impacts of all gear on habitat through the implementation of a comprehensive research plan, monitor habitat recovery, and use the information to determine habitat protection measures as necessary and appropriate.

Alternative 4 – Adopt an Extremely Precautionary Management Policy: This policy shifts the burden of proof to the user and would require that the agency certify that the intended fishery would not have a detrimental effect on the environment before significant fishing could be permitted. The policy, as illustrated by its FMP frameworks, would be to impose very restrictive conservation and management measures that would only be modified or relaxed when reliable scientific information shows that there would be no significant adverse effect. It would involve a strict interpretation of the precautionary principle. Management discussions would involve and be responsive to the public; however, decreased emphasis would be placed on industry and community concerns, and more emphasis would be placed on ecosystem concerns and principles, including the identification and incorporation of non-consumptive use values. The overall premise is that fishing produces adverse impacts on the environment. However, due to a lack of information and uncertainty, we know little about these impacts. Under this policy alternative, impacts to habitat would be reduced and avoided through zoning and limiting fishing gear use to the action area and establishing no-take marine reserves (both pelagic and nearshore) encompassing 20-50 percent of management areas. In fisheries that can be prosecuted with more selective gear, trawling would be prohibited and trawl closure areas would be established. Other policy objectives of Alternative 4 are to manage the fisheries in an explicitly adaptive manner to facilitate learning (including adding large no-take marine reserves that provide experimental controls); to protect marine habitats, including EFH, HAPC, Endangered Species Act-designated critical habitats and other identified habitat types; and to commit to funding a comprehensive research plan.

FMP Bookends: Each policy alternative contains two example FMPs that serve as bookends to a range of management measures that illustrate how the policy could be implemented. These bookends provide a level of detail that allows analysis and provides contrastable policies. They also provide a means to communicate the intended NPFMC actions for achieving a policy, while allowing the NPFMC, under the MSA, the flexibility to adaptively manage the fishery through FMP amendments and the public process.

The bookends are not stand-alone alternatives but rather illustrations that serve to define a range of management actions and potential environmental consequences of a policy alternative. This alternative structure recognizes that the resource being managed, as well as the marine ecosystem, is quite dynamic in nature, and only partially understood. Providing a range of management tools and analyzing their potential effects for each policy alternative attempt to take into account the dynamic nature of the fisheries as a whole and to provide enough management regime flexibility in each alternative to allow the decision-makers to base decisions on the best available science.

3.0 Alternative 1 – Continue Under the Current Risk Averse Management Policy

3.1 Overview of Management Measures Specific to MPAs and EFH

Adequate habitat is essential for maintaining the productivity of fishery resources, and some species or life stages require particular habitats for food, reproduction, and shelter from predators. Under this alternative, the numerous existing fishery closures and/or limitations that protect benthic habitat in the BSAI and GOA would continue (see Table 1 and Figure 1). Alternative 1 measures protecting habitat include fishing seasons and area quotas, fishing gear restrictions, time/area closures (including MPAs and HAPCs) and prohibited species restrictions. The primary focus of these past regulations has been to prevent potential damage to vulnerable crab habitat from bottom trawl gear, and therefore they do not necessarily cross a wide range of habitat types. Some of the trawl closures are in effect year-round while others are seasonal (see Table 1). In general, year-round trawl closures have been implemented to protect vulnerable benthic habitat. Seasonal closures are used to reduce bycatch by closing areas where and when bycatch rates have historically been high. Additional measures to protect the declining western stocks of the Steller sea lion began in 1991 with some simple restrictions based on rookery and haulout locations, and expanded to a more complex suite of fishery restrictions in 2000 and 2001. Most of the areas listed on Table 1 allow fishing by gear other than trawl gear and restrict only those fisheries that target Steller sea lion prey species (e.g., pollock, Pacific cod, and Atka mackerel). However, nine closure areas shown on Table 1 meet the E.O. 13158 criteria of providing lasting protection for part or all of the natural resources on a year-round basis:

- BSAI - Area 512, Pribilof Islands Conservation Area, Red King Crab Savings Area, Steller Sea Rookeries, Nearshore Bristol Bay Closure Area.
- GOA - Year-round Kodiak Trawl Closure, Steller sea lion Rookeries, Southeast Trawl Area Closure, Sitka Pinnacles Marine Reserve.

Expected to continue under the Alternative 1 FMPs are closure areas in the Bering Sea (Red King Crab Savings Area, Nearshore Bristol Bay encompassing Area 512, and Area 516), which together encompass 27,000 square nautical miles (nm²). These areas, along with the Pribilof Islands Conservation Area (7,000 nm²) and the Opilio/Tanner Crab Bycatch Limitation Zone, would continue to be closed to groundfish trawling and/or other specified fisheries such as scallop dredging on a seasonal or prohibited species catch (PSC)-trigger basis to reduce potential adverse impacts on crabs and crab habitat. The shallow areas in particular contain complex living and non-living substrates, which are essential for juvenile crab survival and are potentially sensitive to bottom trawling. Also continuing would be the Chum and Chinook Salmon Savings Areas, the Herring Savings Area, and the Zones 1 and 2 areas. These PSC-triggered closures reduce EFH disturbance for several species and encompass nearly 125,000 nm². The Walrus Islands seasonal closures and the Steller sea lion Critical Habitat and trawl exclusion zones would also continue. State waters (0-3 nm) are also closed to bottom trawling.

In the GOA, several discrete trawl closure areas (Kodiak No-Trawl Zones) covering about 1,500 nm² would continue around Kodiak Island to reduce crab bycatch, but also serve to protect crab habitat. In addition, fishing with all gear types except salmon trolling has been prohibited in an area around two nearshore pinnacles identified as supporting rare, vulnerable, and ecologically important habitat (Sitka Pinnacles Marine Reserve). The year-round Southeast trawl area closure, adopted as part of the License Limitation

Program (LLP), prohibits all trawling east of 140° W longitude and closes about 53,000 nm², of which about 2,000 nm² is located on the shelf. Steller sea lion Critical Habitat and trawl exclusion zones are also identified in the GOA and would continue under Alternative 1. Also, Cook Inlet waters (7,000 nm²) are closed to bottom trawling in order to protect crab habitat; this would continue under Alternative 1.

Figure 4 depicts in detail the existing closure areas specifically described under the existing Alternative 1 policy (1a) and the current FMPs; Table 2 provides the descriptive statistics regarding no-trawl MPAs and no-take marine reserves. Table 3 shows the intended and indirect effects of the closures. As seen in Table 2 and Figure 4, the current FMP offers complete or partial habitat protection for 28.8 percent of fishable area (defined as continental shelf out to the 1,000-m isobath) in the BSAI and GOA combined. Of this 28.8 percent, most (28.5 percent) is designated as "no-trawl MPAs" that may allow seasonal trawling and/or other fishing activities, while only 0.3 percent is designated as no-take marine reserves closed to fishing year-round. Some of the bottom trawl closures are triggered by PSC bycatch limits, while others are seasonal-based on the need to protect certain life stages of crabs (see Table 3). As shown in Table 2, the total closures accounted for in the GOA encompass nearly 46 percent of the fishable area (closed to bottom trawling at one time or another). However, this GOA percentage is greatly influenced by the no-trawl closure in the eastern GOA that protects nearly 82 percent of the fishable area from trawl impacts. Comparatively, 43 percent of the Aleutian Islands and 19 percent of the Bering Sea fishable area is closed at one time or another. The most area that can be defined as no-take marine reserves is found in the Aleutian Islands (1.6 percent due to the Steller sea lion Critical Habitat closures).

Regarding the specific Alternative 1(b) policy goal of responding to new scientific information and evaluating candidate areas for MPAs, the NPFMC currently takes proposals from NOAA Fisheries, ADF&G, the public, and other stakeholders. Areas that are of high concern or are candidates for MPAs are investigated, then acted upon. A recent example of this process occurred with the designation of the Sitka Pinnacles Marine Reserve. In this case, the State of Alaska approached the NPFMC with a request to mirror in Federal waters the protection already in place in State waters. The request went through NPFMC process and the no-take marine reserve area was designated. This process would continue under the alternative.

Another policy goal of Alternative 1(b) is to support the implementation of a comprehensive research plan to evaluate the impacts of trawl gear on habitat and monitor habitat recovery. Since the 1980s, AFSC has been conducting research on the effects of fishing gear on benthic habitat. This research has led to important findings that increase the understanding of the effect of fishing gear effects on benthic habitat. Since 1991, research has specifically focused on four areas:

- Understanding the direct effects of bottom trawling on seafloor habitat;
- Studying the associations of fish and invertebrate species with habitat features that may be affected by fishing gear;
- Evaluating technology to determine gear effects and benthic habitat features; and
- Analyzing the spatial and temporal patterns of bottom trawling, retrospectively.

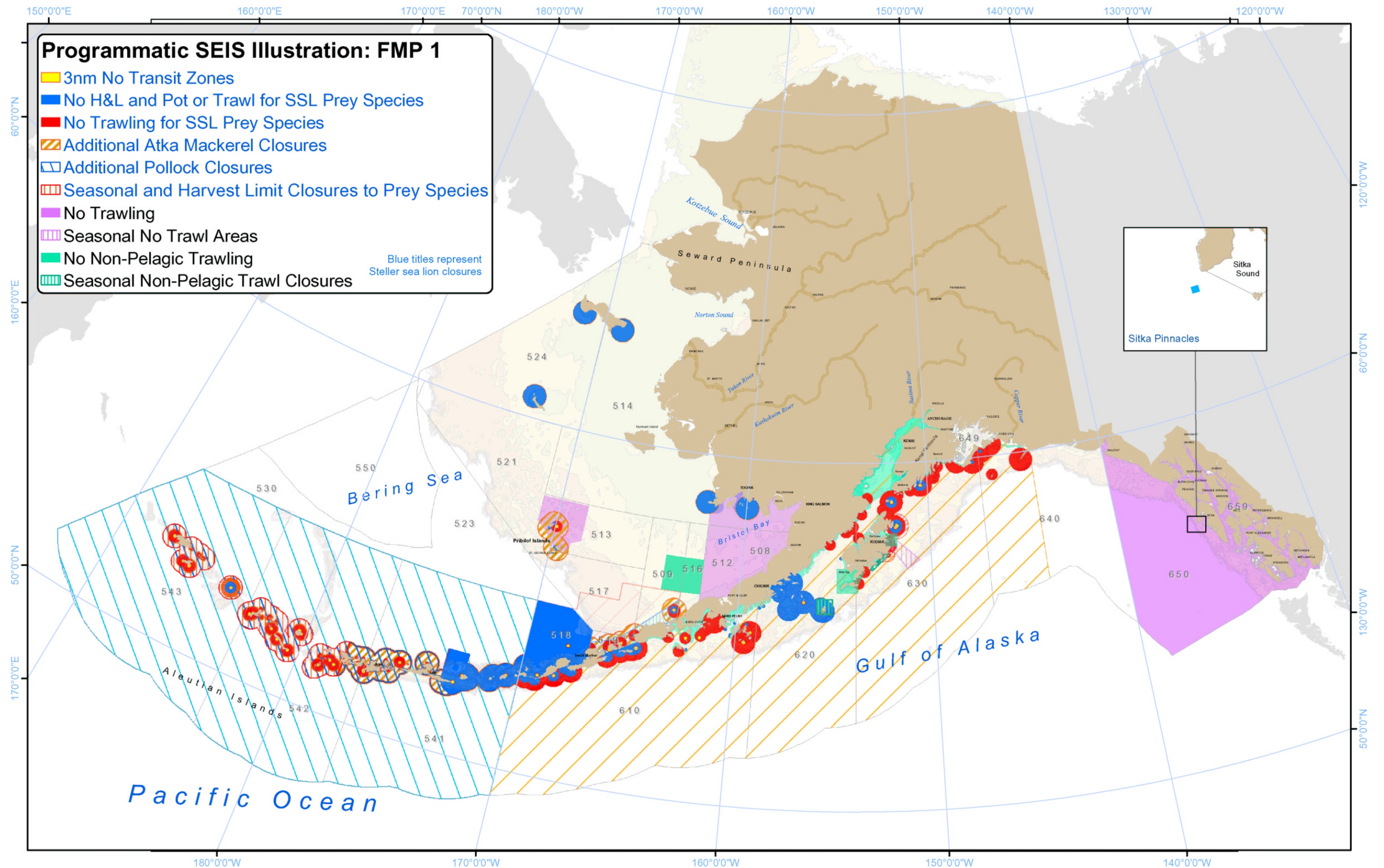


Figure 4. Programmatic SEIS illustration: FMP 1

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Table 2 Descriptive statistics for closure areas under Alternative 1 (as of Jan. 23, 2002)

Current 2002 Trawling Closures^{1 2 3 4 5}			
	Fishable Area	Sq Meters of Mngt	% of Fishable Area
Aleutian Islands			
No Trawl	105380000000	43357506644	41.1%
No Take Reserve	105380000000	1662800000	1.6%
Total	105380000000	45020306644	42.7%
Bering Sea			
No Trawl and Bogoslof	798870000000	153708738278	19.2%
No Take Reserve	798870000000	567620000	0.1%
Total	798870000000	154276358278	19.3%
Entire BS & AI			
No Trawl	904250000000	197066244922	21.8%
No Take Reserve	904250000000	2230420000	0.2%
Total	904250000000	199296664922	22.0%
Cen \ West Gulf W 144			
No Trawl	265690000000	87906000000	33.1%
No Take Reserve	265690000000	1266300000	0.5%
Total	265690000000	89172300000	33.6%
Eastern Gulf - East of 144			
No Trawl	90509000000	73958000000	81.7%
No Take	90509000000	8304042	0% ⁶
Total	90509000000	73966304042	81.7%
Entire Gulf of Alaska			
No Trawl	356199000000	161864000000	45.4%
No Take Reserve	356199000000	1274604042	0.5%
Total	356199000000	163138604042	45.8%
Totals			
Total No Trawl	1260449000000	358930244922	28.5%
Total No Take	1260449000000	3505024042	0.3%
Total FMP Area	1260449000000	362435268964	28.8%

- 1 Closures include SSL protection measures, ADF&G restrictions, and No Transit Zones.
- 2 For consistency with other PSEIS analysis, closures are cut at the 1,000 m boundary with the exception of the Bogoslof foraging area and the Aleutian Islands.
- 3 Pelagic and Non-Pelagic Trawl Closures are included.
- 4 The Steller No Transit areas account for the No Take Reserves. Also includes Sitka Pinnacles (no take marine reserve for groundfish but salmon trolling is allowed).
- 5 With the complexity for the SSL measures in the AI, for this analysis, SSL rookeries and haulouts were buffered at 12.7 nm to effectively close 50 percent of critical habitat.
- 6 Sitka Pinnacles - Percentage is about 0.01 percent so this number appears as 0 percent.

Table 3 **Intended effects of closure areas under Alternative 1**

Closure Area	Year	Region	Closure Type	Closure Purpose	Major Gear Restricted	Main FMP Species Protected	Direct Intent of Closure	Indirect Effect(s) from Closure on EFH and HAPC	Habitats Protected (living and non-living)
Cape Edgecumbe Pinnacles Reserve (Sitka Pinnacles)	1999	GOA	year-round	Habitat	bottom trawl gear jig gear hook & line gear anchoring	Rockfish spp. adults Rockfish spp. juveniles	Closure to all groundfish commercial fishing and vessel anchoring to protect rare and ecologically important habitat. Troll fishing for salmon is allowed.	None.	epifauna HAPC pinnacle
Southeast Alaska No-Trawl Area	1998	GOA	year-round	Habitat	all trawl gear	Corals Sponges Groundfish	Adopted as part of the license limitation program but covers a vast area of deep water living substrates, including red tree coral.	Benthic habitat, HAPC, groundfish, and non-FMP crab previously impacted by trawl gear are no longer subject to disturbance, damage, and/or direct and indirect mortality.	epifauna infauna nearshore slope shelf
Kodiak Red King Crab Savings Area	1986	GOA	year-round; seasonal	Habitat Species	bottom trawl gear scallop dredge gear	Red king crab adults	Closure to protect adult red king crab concentrations, juvenile rearing areas, migration patterns, and recruitment.	Benthic habitat, HAPC, and groundfish previously impacted by bottom trawl and dredge gear are no longer subject to disturbance, damage, and/or direct and indirect mortality.	epifauna infauna shell hash slope shelf
Pribilof Islands Habitat Conservation Area	1995	BS	year-round	Habitat	all trawl gear scallop dredge gear	Blue king crab juveniles	Closure to protect important areas for juvenile blue king crab survival.	Benthic habitat, HAPC, and groundfish previously impacted by gear are no longer subject to disturbance, damage, and/or direct mortality.	shell hash slope shelf
Bristol Bay Nearshore Closure	1997	BS	year-round	Habitat	all trawl scallop dredge gear	Red king crab juveniles	Closure to protect juvenile red king crab and rearing habitats. Expanded Area 512 closure (see below).	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by gear are no longer subject to disturbance, damage, and/or direct mortality.	emergent epifauna shell hash HAPC shallows sand slope
Red King Crab Saving Area 512 (Middle Bristol Bay)	1987	BS	year-round	Species Habitat	all trawl gear scallop dredge gear	Red king crab juveniles and adults	Closure to protect high densities of red king crab adults and juvenile rearing habitats.	Benthic habitat, HAPC, juvenile crab, and groundfish previously impacted by gear are no longer subject to disturbance, damage, and/or direct mortality.	epifauna infauna sand shelf

Table 3 (cont.) Intended effects of closure areas under Alternative 1

Closure Area	Year	Region	Closure Type	Closure Purpose	Major Gear Restricted	Main FMP Species Protected	Direct Intent of Closure	Indirect Effect(s) from Closure on EFH and HAPC	Habitats Protected (living and non-living)
Red King Crab Savings Area 516 (Outer Bristol Bay)	1987	BS	seasonal; March 15 to June 15	Species	bottom trawl gear scallop dredge gear	Red king crab adults	Closure to protect high densities of red king crab adults and halibut.	Benthic habitat, HAPC, juvenile crab, and groundfish previously impacted by bottom trawl and dredge gear are no longer subject to disturbance, damage, and/or direct mortality.	epifauna infauna sand/mud shelf
Opilio and Tanner Crab Bycatch Limitation Zones	1997	BS	Inseason PSC Cap	Species	trawl gear	Tanner crab adults Snow crab adults	Closed to specified groundfish fisheries when crab bycatch trigger is reached in order to reduce mortalities to crab and egg-laden mature crabs.	Benthic habitat, HAPC, and groundfish, and crab previously impacted by bottom trawl gear are no longer subject to disturbance, damage, and/or direct mortality.	emergent epifauna shelf
Chinook Salmon Savings Area	1995	BS	trigger	Species	pelagic trawl gear	Chinook salmon late juveniles - marine Chinook salmon adults - marine	Areas closed to trawling should the chinook salmon bycatch exceed 48,000 chinook (a period of high chinook bycatch). For 2003 the cap is reduced to 29,000 and this applies only to vessels fishing for pelagic pollock. The accounting towards the cap begins Jan 1 st and the area will be closed for the remainder of the year should the cap be reached.	Maturing chinook salmon previously recruiting to pelagic trawl gear are afforded greater protection to potentially reach maturity and spawning areas. Seasonal timing directly corresponds with migratory patterns and concentrations of maturing salmon within fishing areas.	
Chum Salmon Savings Area	1995	BS	seasonal: closed August; limited September through October 15	Species	trawl gear	Chum salmon late juveniles - marine Chum salmon adults - marine	To reduce excessive bycatch of other (mainly chum) salmon in groundfish trawl fisheries; the area is closed to trawling only during the month of August. The area is re-opened on September 1, but can be closed if the total bycatch of chum in the surrounding area should exceed 42,000 salmon.	Maturing chum (and other) salmon previously recruiting to pelagic trawl gear are afforded greater protection to potentially reach maturity and spawning areas. Seasonal timing directly corresponds with migratory patterns and concentrations of maturing salmon within fishing areas.	

Table 3 (cont.) Intended effects of closure areas under Alternative 1

Closure Area	Year	Region	Closure Type	Closure Purpose	Major Gear Restricted	Main FMP Species Protected	Direct Intent of Closure	Indirect Effect(s) from Closure on EFH and HAPC	Habitats Protected (living and non-living)
Herring Savings Areas	1995	BS	trigger	Species	trawl gear	Bycatch species	Established to limit the amount of herring taken as bycatch in the trawl fisheries. Two of the areas are closed in the summer and one in the winter.	An important prey resource of groundfish are afforded greater protection during spawning and migratory concentrations.	nearshore offshore
State of Alaska Nearshore Waters Closure	2000	GOA, AI, BS	year-round	Habitat	all bottom trawl gear	Nearshore adult and juvenile salmon, crab, shellfish, and groundfish	Close all State waters (0-3 nm) to commercial bottom trawling to protect nearshore habitats and species.	None.	nearshore nursery and adult areas HAPC slope
Cook Inlet No-Trawl Zone	2001	GOA	year-round	Habitat	bottom trawl gear	Bycatch species	Prohibit non-pelagic trawling in Cook Inlet to control crab bycatch mortality and protect crab habitat in an area with depressed king and Tanner crab stocks. Includes areas in State waters.	Benthic habitat, HAPC, groundfish , and non-fmp crab previously impacted by bottom trawl gear are no longer subject to disturbance, damage, and/or direct mortality.	shallows
Adak Scallop Closure Area	1995	AI	year-round	Habitat	scallop dredging	Scallops, groundfish, crab	Closure to prevent scallop dredging in biologically critical areas: reduce high bycatch of other species (i.e., crabs); avoid nursery for groundfish and shellfish; avoid sensitive habitats.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by dredging are no longer subject to disturbance, damage, and/or direct mortality.	sand mud
Dutch Harbor Scallop Closure Area	1995	BS, AI	year-round	Habitat	scallop dredging	Scallops, groundfish, crab	Closure to prevent scallop dredging in biologically critical areas: reduce high bycatch of other species (i.e., crabs); avoid nursery for groundfish and shellfish; avoid sensitive habitats.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by dredging are no longer subject to disturbance, damage, and/or direct mortality.	sand mud

Table 3 (cont.) Intended effects of closure areas under Alternative 1

Closure Area	Year	Region	Closure Type	Closure Purpose	Major Gear Restricted	Main FMP Species Protected	Direct Intent of Closure	Indirect Effect(s) from Closure on EFH and HAPC	Habitats Protected (living and non-living)
Kodiak Scallop Closure Area	1995	GOA	year-round	Habitat	scallop dredging	Scallops, groundfish	Closure to prevent scallop dredging in biologically critical areas: reduce high bycatch of other species (i.e., crabs); avoid nursery for groundfish and shellfish; avoid sensitive habitats.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by dredging are no longer subject to disturbance, damage, and/or direct mortality.	sand mud
Alaska Peninsula Scallop Closure Area	1995	GOA	year-round	Habitat	scallop dredging	Scallops, groundfish, crab	Closure to prevent scallop dredging in biologically critical areas: reduce high bycatch of other species (i.e., crabs); avoid nursery for groundfish and shellfish; avoid sensitive habitats.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by dredging are no longer subject to disturbance, damage, and/or direct mortality.	sand mud
Bering Sea Scallop Closure Areas	1995	BS	year-round	Habitat	scallop dredging	Scallops, groundfish, crab	Closure to prevent scallop dredging in biologically critical areas: reduce high bycatch of other species (i.e., crabs); avoid nursery for groundfish and shellfish; avoid sensitive habitats.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by dredging are no longer subject to disturbance, damage, and/or direct mortality.	sand mud
Bogoslof Groundfish Closure Area	1992	BS	year-round	Marine Mammal	bottom trawl gear	Walleye pollock, Pacific cod, Atka mackerel	Closure to Walleye pollock, Atka mackerel, and Pacific cod commercial bottom trawl fisheries associated with the SSL protection measures.	Walleye pollock, Atka mackerel, and Pacific cod adults previously taken by their directed fishery are afforded greater protection to potentially reach maturity. Additionally, benthic habitats and HAPC will be subject to less bottom trawling intensity levels, but not total protection. Fisheries, other than these three, may still be prosecuted with bottom trawl gear.	nearshore nursery and adult areas HAPC nearshore slope shelf

Table 3 (cont.) Intended effects of closure areas under Alternative 1

Closure Area	Year	Region	Closure Type	Closure Purpose	Major Gear Restricted	Main FMP Species Protected	Direct Intent of Closure	Indirect Effect(s) from Closure on EFH and HAPC	Habitats Protected (living and non-living)
SSL Closure Areas	2000	GOA, BS, AI	year-round	Marine Mammal	bottom trawl gear	Walleye pollock, Atka mackerel, Pacific cod	Steller sea lion foraging areas for prey. Indirectly protecting EFH within the closed areas. 10-20 mile no-trawl zones around sea lion rookeries. Additional closures to protect critical habitat enacted in 1999.	Walleye pollock, Atka mackerel, and Pacific cod adults previously taken by their directed fishery are afforded greater protection to potentially reach maturity. Additionally, benthic habitats, HAPC, and other nearshore groundfish will be subject to less bottom trawling intensity levels, but not total protection. Fisheries, other than these three, may still be prosecuted with bottom trawl gear.	rock beaches pinnacles kelp nearshore
SSL Major Rookeries	1995	GOA, BS, AI	year-round	Marine Mammal	all gear no vessel entry	Nearshore adult and juvenile salmon, crab, shellfish, and groundfish	SSL major rookeries and haulout areas used as foraging areas, reproductive areas, and social interactions.	Groundfish, shellfish, and crab are afforded protection from any disturbance, damage, or mortality.	nearshore
Walrus Islands Federal Closure	1995	BS	seasonal: April 1 through September 30	Marine Mammal	all gear	Groundfish and crab	All fishing vessels prohibited between 3 and 12 miles to protect walrus in the water.	Benthic habitat, HAPC, and nearshore areas supporting juvenile and adult groundfish and crab previously impacted by fishing are no longer subject to disturbance, damage, and/or direct mortality.	nearshore nursery and adult areas HAPC slope

AI - Aleutian Islands
 BS - Bering Sea
 EFH - Essential Fish Habitat
 FMP - Fishery Management Plan
 GOA - Gulf of Alaska
 HAPC - habitat area of particular concern
 nm - nautical miles
 SSL - Steller sea lion

Most of the field-oriented studies have focused on small geographic areas in specific habitat types (see Figure 3). Similarly, in the last few years, the U.S. Geological Survey Coastal and Marine Geology Program has applied high resolution mapping tools to map benthic habitats in Alaska. These mapping efforts address small specific areas and localized issues. With additional funding, expansion of NOAA Fisheries and U.S. Geological Survey research efforts over larger geographic areas and a variety of habitat types will provide fisheries managers the information needed to develop measures for minimizing impacts and determining appropriate habitat protection measures. Additional information concerning existing and planned research can be found at <http://www.afsc.noaa.gov/abl/MarFish/geareffects.htm>.

3.2 Effects of MPA/EFH Management Measures of the Alternative 1 Policy

Specific impacts to habitat from different management regimes are very difficult to predict. To evaluate the effects of fishing on habitat features, detailed information on the distribution and abundance of habitat types, the life history of living substrates, and the natural disturbance regime is needed. This information is generally incomplete for Alaskan waters. Knowledge of how fishing affects different habitat types under a variety of circumstances has been summarized by NMFS (2002). Presently it is not possible to fully and quantitatively account for all factors involved in determining how an ecosystem will respond to fishing activities. Given those caveats, this evaluation of the Alternative 1 policy is illustrated by the current groundfish FMP. The subsequent evaluation of the additional alternatives and their respective FMP bookends provides a qualitative discussion of impacts, assuming that greater habitat disturbance is expected with less habitat protection. Therefore, in analyzing the effects of fishing gear on habitat, two simplifying assumptions are made:

- Closing areas to trawling, at least part of the time, or designating no-take reserves, benefits EFH by lessening the occurrence of the impact; thus the habitat becomes less vulnerable to disturbance-induced changes; and
- Increasing fishing effort in an area puts additional stress on EFH in that area.

These assumptions are applied directly to the question of whether the alternative is likely to impact the physical, biological, or social and economic environments. They are used throughout this document to discuss potential impacts of each alternative policy through analysis of its associated illustrative FMP.

Effects on the Physical Environment

Non-living substrates and features such as boulders, cobbles and sand waves can be disturbed by bottom trawls (Auster and Langton 1999). For example, gear can overturn boulders and cobbles and smooth sand waves. In addition, boulder piles could be dispersed, thus reducing the number of crevices. In most cases the structural integrity, and hence the complexity of the habitat, would not be greatly reduced (NMFS 2001a,b). Therefore, any impacts of Alternative 1 on the physical environment (substrate) are expected to be neither beneficial nor adverse (e.g., no significant impact).

Effects on the Biological Environment

EFH - Benthic Biodiversity

Alternative 1 as illustrated through the current FMPs could impact biodiversity of benthic invertebrates and fish. The adverse effects of bottom trawling and other mobile fishing gears on benthic biodiversity have been documented for Alaska and other regions (Auster and Langton 1999, McConaughy *et al.* 2000, Freese 1999, NRC 2002 and see Section 3.6). This conclusion is further supported by past recognition that the existing management regime (i.e., Alternative 1) has had impacts that justify year-round bottom trawl closure areas in order to provide some protection to EFH.

The spatial distribution of the closed areas under the current FMPs may not protect the full range of habitat types in the BSAI and GOA. This is because many fish species depend on particular habitat features during various life stages. One way to protect benthic biodiversity is a properly designed network of marine reserves (NRC 2001, Murray *et al.* 1999). Given the limited information on distribution and abundance of habitat types in waters off Alaska, evaluation of the impacts of the Alternative 1 policy is based primarily on the size of bottom trawl closure areas and secondarily on the spatial distribution of these closure areas.

As shown in Figure 4 and Table 2, Alternative 1 closes nearly 29 percent of the total FMP area (BSAI and GOA combined) at various times throughout the year. Closures within various subareas range from 19 percent to nearly 82 percent. Although these percentages are near, or greatly exceed, the 20 percent closure recommendation for marine reserves (Agardy 1994, Lauck *et al.* 1998, Allison *et al.* 1998), the primary focus of the current FMPs is protection of crab habitat and Steller sea lion critical habitat. This habitat is generally relatively shallow; thus, the closures do not encompass a wider range of habitat types and depths, which would protect a wide range of EFH for species that inhabit deep water. The exception is the bottom trawl closure in the eastern GOA, which encompasses a wide range of habitat types and depths. There are generally no area restrictions in the deeper waters that encompass the outer continental shelf and upper slope of the central and western GOA and BSAI. The Aleutian Islands region, in particular, is an area with high habitat complexity and high abundance and diversity of coral species (Heifetz 2002). Within the areas currently open to bottom trawl fishing, specific areas or "hotspots" are fished each year, while other areas are undisturbed or fished very lightly (Coon and Heifetz 1999, Fritz *et al.* 1998). Presumably, an area is repeatedly trawled because there are high catches per unit of effort of target species, and the bottom topography is suitable (i.e., trawlable). In many cases, these areas likely correspond to the preferred habitat of adult groundfish species, and are often fished seasonally.

The closures to bottom trawling are in many cases not year-round, and do not restrict fixed-gear use. In some cases, fixed-gear may adversely impact benthic biodiversity. Some specific geographic areas with sensitive habitat (e.g., gorgonian corals) are probably the most susceptible to fixed-gear impacts. Under Alternative 1 as illustrated by the current FMPs, there is a near absence of year-round closures to all fishing, with no-take marine reserves constituting only 0.3 percent of the fishable area (see Table 2). A higher percentage of no-take marine reserves would provide a wider range of protection for EFH from disturbances caused by all gear at all times. (See the analyses of Alternatives 3 and 4, below, for a discussion of the environmental consequences of such an increase.)

EFH - HAPCs

HAPCs include living substrates that provide high micro-habitat complexity, which serves as cover for groundfish and other organisms. A detailed description of HAPC as related to EFH is provided in Section 3.6. Five groups of organisms have been identified as deepwater HAPCs in Alaska: coral, sponges, anemones, sea whips, and sea pens.

Documentation of localized depletions, changes in benthic community structure, and acute damage all indicate that HAPC biota and other living substrates are directly impacted by bottom trawl fisheries (Freese *et al.* 1999, McConaughy *et al.* 2000). Criteria to determine acceptable levels of mortality to HAPC biota have not been established. Such criteria would need to consider fishing-induced mortality relative to such characteristics as natural mortality, fecundity, abundance, and growth rates. Many of the deep water areas that HAPC biota inhabit are characterized as stable environments dominated by long-lived species. In such areas the impacts of fishing can be substantial and long term (Auster and Langton, 1999). Species such as gorgonian red tree coral (*Primnoa*) are very long lived (more than 100 years old), and would therefore not easily recover if damaged by bottom trawls or some other gear type (Risk *et al.* 1998, Andrews *et al.* 2002, Krieger and Wing 2002).

Gorgonian coral has been harvested throughout the world for use as jewelry. In general, corals and sponges are traded worldwide. Specific protective measures for HAPC biota (Amendment 65 in BSAI and GOA FMP), were developed and approved by the NPFMC to prohibit the sale of gorgonian coral and sponges, prior to the development of such a fishery in Alaska. However, in February of 2001, NOAA Fisheries informed the NPFMC that they would not be pursuing Amendment 65 regulations and instead suggested that the most efficient option would be for the NPFMC to request the State of Alaska to prohibit commercial fishing for these HAPC species in the EEZ outside of State waters. The MSA provides authority for the State to regulate a vessel in the EEZ, even if it is not registered under the State of Alaska laws. The State could use this authority to prohibit a commercial fishery for HAPC species in the EEZ, provided that the necessary determinations are made under MSA Section 306(a)(3). It is presumed that this process could move forward under the Alternative 1 policy.

Living substrate can be inadvertently impacted through fishing activities that are not directed on the HAPC itself (i.e., damage by bottom trawls, longlines, and pot gear, and bycatch of HAPC biota in other fisheries). Therefore, with respect to groundfish fisheries that use both mobile and fixed gear, a certain amount of bycatch, unobserved damage, and mortality to HAPC biota is expected to occur under the Alternative 1 policy and existing FMPs. Existing management measures under the current groundfish FMPs that were put into place to protect prohibited species and Steller sea lions, close about 22 percent and 46 percent of fishable area in the BSAI and GOA, respectively, to bottom trawling (see Table 2). However, these areas are not necessarily closed year-round, do not incorporate concurrent reductions in total allowable catch (TAC), and do not close the areas to fishing with fixed gear. In addition, the trawl closures are specific only to three directed bottom fisheries: pollock, Pacific cod, and Atka mackerel. Thus, bottom trawling for other groundfish such as rockfish and flatfish may still occur in some of the closed areas. As such, the closures are likely to benefit EFH (including HAPC) in some areas by reducing the level and frequency of disturbance, but could possibly increase stresses on the habitat elsewhere, and at an unknown rate, where fishing is intensified. Some marginal grounds not previously fished could possibly now be disturbed due to the closures, particularly since concurrent reductions in TAC would not accompany the closures. Not having experienced as much fishing effort in the past, these areas could be more vulnerable to trawling impacts. In

addition, damage to HAPCs by pot and fixed gear; and by trawling for rockfish and flatfish; is not mitigated by the closures since this type of fishing is not restricted in these areas. Therefore, Alternative 1 policy as illustrated by the current BSAI and GOA groundfish FMPs has the potential to increase trawl effort in areas that could have high concentrations of HAPC species.

Target, Non-Target, and Forage Fish

The closure areas in place in the BSAI and GOA under the Alternative 1 policy as illustrated by the current FMPs generally have been designed to protect various prohibited species, but could provide indirect benefits to target and non-target groundfish species as well (see Table 3). As shown in Table 3, many of the existing seasonal and year-round closure areas are intended to protect the prohibited species (crab, salmon, halibut, and herring). The issue of localized depletion of pollock and other target groundfish species is also addressed indirectly by the Bogoslof closure, which was primarily designated as part of the Steller sea lion Protection Measures.

Forage Fish

Most of the forage fish bycatch is taken in pelagic trawls (74 percent in the BSAI, 93 percent in the GOA) (NMFS 2001a). The vast majority of forage fish taken as bycatch consists of osmerids (capelin, eulachon, other smelts). Collectively, forage fish form only a small part of bycatch of groundfish fisheries, typically comprising less than 1 percent of any directed harvests. The low volume of incidental catch of forage fish currently observed under the existing FMPs is anticipated to continue under Alternative 1.

Prohibited Species

The Alternative 1 policy as illustrated by the existing FMPs moves fishing effort outside of Steller sea lion Critical Habitat areas compared to the historic catch from 1997-1999. Chinook salmon, other Tanner crab, and halibut bycatch rates appear to be lower outside of critical habitat, and the shift in effort outside of these areas leads to reductions in the expected bycatch of these three prohibited species (NMFS 2001b). Existing closures have been put into place to protect these species by reducing bycatch and protecting habitat.

Marine Mammals

Also shown in Table 3 are the closures intended to protect marine mammals, namely Steller sea lions. One or more of the target species (pollock, Atka mackerel, and Pacific cod) have been identified as prey species of Steller sea lions, certain whales, and fur and harbor seals. Trawl limitations described above for these prey species will indirectly benefit these marine mammals also (NMFS 2001b).

For example, trawl closures around the Pribilof Islands, established mainly for the protection of crab stocks, may offer positive benefits to fur seals by limiting prey removals in waters surrounding their Pribilof Island rookeries. However, only northern fur seals foraging close to the islands would benefit, and recent tracking studies show that foraging trips of both adult female and juvenile male fur seals extend well beyond the trawl closure boundaries. Therefore, while fisheries harvest prey of northern fur seals (i.e., pollock and Pacific cod), competition due to the harvest rates of those species may vary depending on the size range consumed by the seals.

Since fishing vessels would either be eliminated (no-take marine reserves) or reduced (no-trawl MPAs), direct effects such as mortality and direct disturbance of marine mammals would also be eliminated or reduced in the closure areas, depending on the type and season of closure. Therefore, it may be anticipated that protection from direct (mortality, direct disturbance) and indirect (loss of prey) effects would be provided.

Seabirds

None of the closure areas currently in place are specifically designed to protect or enhance seabird populations. However, some of the nearshore closures may indirectly benefit seabirds by benefitting forage fish populations. However, as described above, the small amount of average incidental catch in the BSAI and GOA, as occurs under the existing FMPs, is not likely to significantly affect the abundance of forage fish available for seabirds.

The incidence of direct mortality due to seabird/vessel collisions and inadvertent take of seabirds by fishing vessels also would not occur in the year-round closed areas; however, these areas comprise only a very small percentage of the overall closure areas. The protection for seabirds would occur to a lesser extent, if at all, in the seasonally closed areas, since many of these areas remain open to longline fishing, which has the greatest potential for direct take of seabirds. Additional discussions on the impacts of Alternative 1 on seabirds are discussed in the Seabird Qualitative Impact Assessment (Appendix F-6).

Effects on the Social and Economic Environment

Under the existing FMPs, the BSAI and GOA groundfish fisheries are expected to continue to provide high and relatively stable levels of seafood products to domestic and foreign markets. However, as compared to a no-closure scenario, Alternative 1 would produce socioeconomic effects that vary by industry sector (catcher vessel, catcher processor, and inshore processor), fishery, and region. While these effects are quantified and discussed in detail in Chapter 4 of the Programmatic SEIS, a brief qualitative discussion is provided herein.

Due to longer transit times to reach open areas, the critical habitat and other closures existing under the current FMPs likely lower catch and increase the cost of harvesting a given amount of fish. The existing closures affect the industry by increasing travel time to and from distant fishing grounds compared to prior years when such closures were not in effect. Time associated with learning how to fish new fishing grounds, reducing catch per unit of fishing effort from fishing less concentrated stocks, increasing down time and layoffs all contribute to increasing costs to processors. If the operating costs increase, these would be expected to have some impacts on the market. Catcher processors and inshore processors would face competition from and loss of market share to foreign fisheries and farmed fish if product price increases while product quality decreases. Operating costs for catcher vessels and product values for inshore processors would be exacerbated by adverse trends in salmon and crab fisheries, particularly in the Alaska Peninsula, Aleutian islands, and Kodiak Island Borough (NMFS 2001b).

Since the closed areas result in greater distances between ports and open fishing grounds and require fishing further offshore, vessels will incur an increased risk of accidents and injury (NMFS 2001b). Smaller catcher vessels based out of the Alaska Peninsula, Aleutian Islands, and Kodiak communities would have to travel

further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch and exposing the vessels to additional risks due to hazardous weather conditions.

On the other hand, the Alternative 1 closures as illustrated by the current FMPs could benefit non-market issues such as existence values and eco-tourism. Studies have shown that the general public is willing to pay for the existence of species (and the preservation of endangered species) as well as the preservation of wilderness areas (NMFS 2001b). While estimates of non-consumptive and non-use values for various levels of the BSAI and GOA ecosystems are not available, it can be assumed that the closures under the existing FMPs serve to enhance these values to an unknown extent.

Effects on the Ecosystem

As described previously under Benthic Biodiversity, the primary focus of the Alternative 1 closure areas is protection of vulnerable life history stages of crab, crab habitat, and Steller sea lion critical habitat. This habitat is generally relatively shallow; thus, the closures do not encompass a wide range of habitat types and depths. While predator/prey relationships could be improved in closed areas, particularly in the year-round closure areas and "no-transit" areas, effects on the ecosystem as a whole are unlikely. If the closures were to cover a wider range of habitats, then improved protection for a wide range of species could be realized, eventually benefitting overall species diversity. Therefore, due to the narrow focus of the closures, beneficial effects on top predators, energy flow, and balance are also unlikely to be realized.

Effects on Management and Enforcement

Under existing management, it is unlawful for any person to operate a vessel authorized to participate in the Atka mackerel, Pacific cod, or pollock directed fisheries in any BSAI or GOA reporting areas, unless the vessel carries an operable NOAA Fisheries-approved vessel monitoring system (VMS) transmitter. The only exemption is for vessels using jig gear. This requirement would continue under the Alternative 1 policy as illustrated by the current FMPs.

As such, VMS is an essential component of monitoring and enforcement for closure areas. In the absence of VMS, enforcement of compliance with closed areas would be limited to random sightings by enforcement vessels or aircraft. To monitor critical habitat harvest limits, managers need to know which vessels fished in the area and how much fish they caught. VMS data provide real-time information on vessel location and indicate fishing activity. These VMS data can be matched with observer data or landing data for the trip to determine if the catch is counted against the catch limit.

By allowing fishing to continue, the VMS requirement has a positive economic effect on fishery participants and fishing communities. Many important fishing grounds are found within Steller sea lion Critical Habitat. The Steller sea lion Protection Measures, including VMS, were developed to afford vessels an opportunity for continued access to those grounds. Allowing that access, with addition of the VMS requirement, is preferred by the fishing industry to closing the areas entirely. The VMS reporting system is discussed further in the Data and Reporting Requirements Qualitative Impact Assessment (Appendix F-11).

The observer program, which is discussed in detail in Appendix F-10 (see the Observer Program Qualitative Analysis), would also continue under this alternative and these FMPs. Under the program, vessels greater than 125 feet (ft) must carry an observer at all times; vessels between 60 ft and 125 ft are required to carry

observers for only 30 percent of the vessel's time at sea, and vessels that are less than 60 ft are exempt from observer coverage. With these levels of observer coverage, NOAA Fisheries is confident that most of the groundfish harvest is being observed and that with observers on board, fishing vessels are unlikely to venture into closed areas.

4.0 Alternative 2 – Adopt a More Aggressive Management Policy

4.1 Overview of EFH/MPA Management Measures of FMP Bookend 2.1

This bookend to the Alternative 2 policy proposes that no MPAs be designated. This FMP is intended to illustrate a management regime where a more aggressive harvest strategy is employed with fewer restrictions on fishing. It would repeal all current closed/restricted areas intended to protect crab habitat and other prohibited species such as salmon and herring. In addition, the Sitka Pinnacles Marine Reserve, intended to protect sensitive habitat and HAPC, would be repealed. Only the Steller sea lion Protection Measures to avoid a determination of jeopardy under the Endangered Species Act would remain in place.

Figure 5 depicts the existing closure areas under FMP bookend 2.1; Table 4 provides the descriptive statistics regarding no-trawl MPAs and no-take marine reserves. As seen in Table 4 and Figure 5, FMP 2.1 would provide limited protection to 14.6 percent of fishable area in the GOA and BSAI combined, with 14.3 percent designated as no-trawl areas, leaving just 0.3 percent as no-take marine reserve areas (Steller sea lion No Transit Zones). Also shown in Table 4, about 22 percent of the fishable area in the entire GOA would be closed to bottom trawling at one time or another under this FMP illustration. Comparatively, about 43 percent of the Aleutian Islands and nearly 8 percent of the Bering Sea fishable area would be closed. Most of the no-take marine reserve areas defined by FMP 2.1 are found in the Aleutian Islands (1.6 percent) due to the number of Steller sea lion Critical Habitat closures located there. Only a small percentage (0.5 percent) of fishable area in the GOA is afforded complete protection, again for the purposes of protecting Steller sea lions.

4.2 Effects of EFH/MPA Management Measures of FMP Bookend 2.1

Effects on the Physical Environment

There will be additional impacts on the substrate under FMP 2.1 since areas presently closed to bottom trawling would be opened. Depending on the intensity of the trawling in a given location, the physical impacts on the substrate itself may be notable. However, as described for the Alternative 1 policy and current FMPs, the structural integrity and complexity of the overall habitat found in the BSAI and GOA would not be greatly reduced by this FMP, but there could be localized areas of significant disturbance as a result of concentrated fishing effort.

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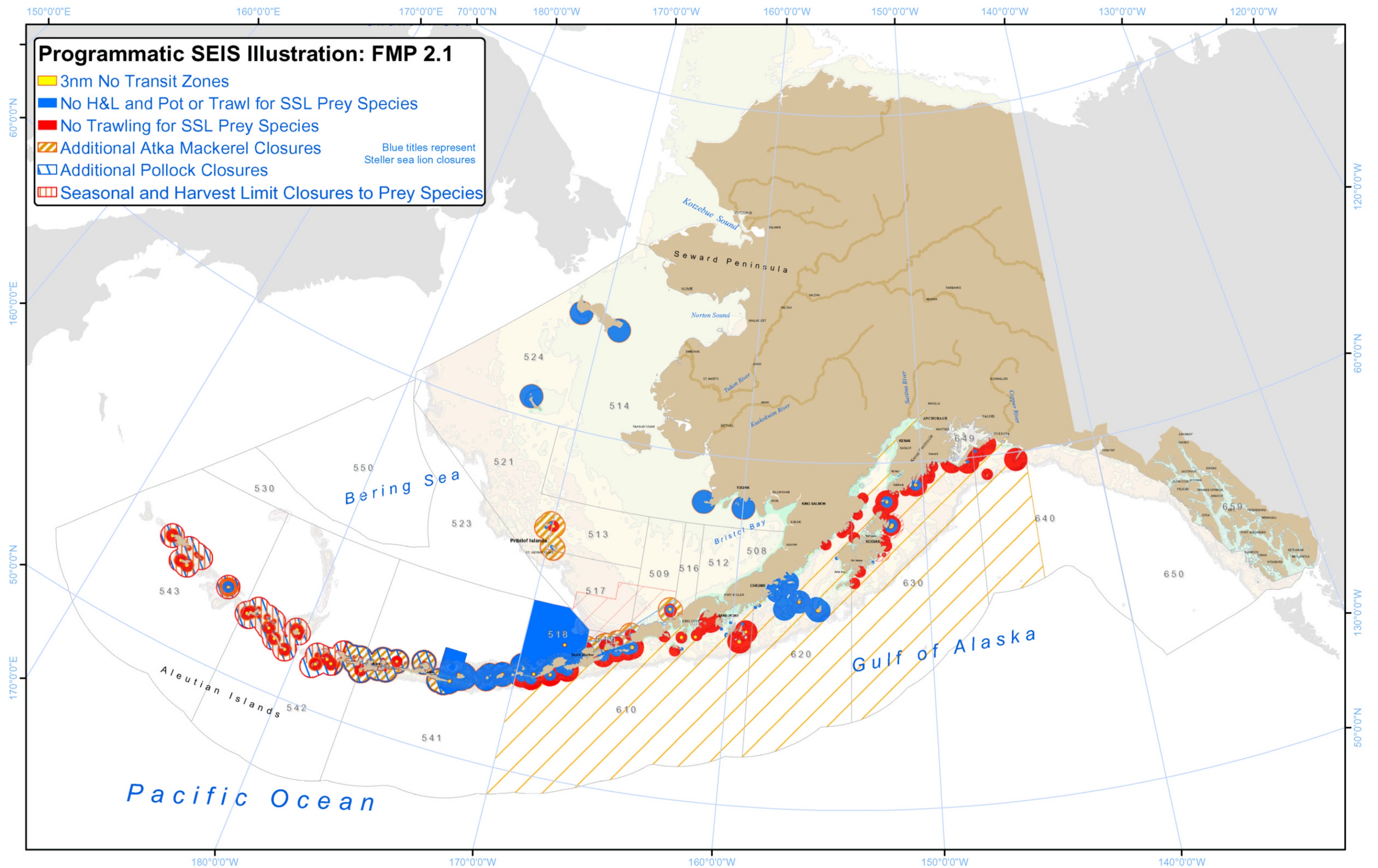


Figure 5. Existing closure areas in FMP bookend 2.1

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Table 4 Descriptive statistics for closure areas under FMP scenario 2.1

Current 2002 SSL Protection Measures ^{1 2 3}			
	Fishable Area	Sq Meters of Mngt	% of Fishable Area
Aleutian Islands			
No Trawl	105380000000	43357200000	41.1%
No Take Reserve	105380000000	1662800000	1.6%
Total	105380000000	45020000000	42.7%
Bering Sea			
No Trawl and Bogoslof	798870000000	59826380000	7.5%
No Take Reserve	798870000000	567620000	0.1%
Total	798870000000	60394000000	7.6%
Entire BS & AI			
No Trawl	904250000000	103183580000	11.4%
No Take Reserve	904250000000	2230420000	0.2%
Total	904250000000	105414000000	11.6%
Cen \ West Gulf W 144			
No Trawl	265690000000	77406700000	29.1%
No Take Reserve	265690000000	1266300000	0.5%
Total	265690000000	78673000000	29.6%
Eastern Gulf - East of 144			
No Trawl	905090000000	0	0.0%
No Take	905090000000	0	0.0%
Total	905090000000	0	0.0%
Entire Gulf of Alaska			
No Trawl	356199000000	77406700000	21.7%
No Take Reserve	356199000000	1266300000	0.5%
Total	356199000000	78673000000	22.2%
Totals			
Total No Trawl	1260449000000	180590280000	14.3%
Total No Take	1260449000000	3496720000	0.3%
Total FMP Area	1260449000000	184087000000	14.6%

- 1 Closures include the trawling SSL protection measures and No Transit Zones. Most H&L and Pot closures overlap the trawl closures.
- 2 For consistency with other PSEIS analysis, closures are cut at the 1,000- meter boundary with the exception of the Bogoslof and Seguam Pass foraging areas.
- 3 With the complexity for the SSL measures in the AI, for this analysis, SSL Rookeries and Haulouts were buffered at 12.7 nm to effectively close 50 percent of critical habitat.

Effects on the Biological Environment

EFH – Benthic Biodiversity

FMP bookend 2.1 could impact biodiversity of benthic invertebrates and fish. It is recognized that the spatial distribution of the closed areas under the scenario may not protect the full range of habitat types in the BSAI and GOA. This is because many fish species depend on particular habitat features. One way to protect benthic biodiversity is a properly designed network of marine reserves (NRC 2001, Murray *et al.* 1999). This scenario recommends repealing many existing MPAs and closure areas.

As shown in Table 4, FMP 2.1 closes about 12 percent of the BSAI and about 22 percent of the GOA with about 15 percent of the total FMP area (BSAI and GOA combined) closed at various times throughout the year. Although these percentages are near the 20 percent closure recommendation for marine reserves (Agardy 1994, Lauck *et al.* 1998, Allison *et al.* 1998), they are not true marine reserves as described above. The primary focus of the closure areas is protection of Steller sea lion Critical Habitat. The closures to bottom trawling are in many cases not year-round, and do not restrict fixed-gear use, and close fishing for only target certain species (pollock, Pacific cod, and Atka mackerel). Bottom trawling for flatfish and rockfish is still allowed within certain areas of the designated critical habitat. Also, in some cases, fixed-gear may adversely impact benthic biodiversity. Some specific geographic areas with sensitive habitat (e.g., gorgonian corals) are probably the most susceptible to fixed-gear impacts. Under FMP 2.1, there is a near absence of year-round closures to all fishing; no-take marine reserves constitute only 0.3 percent of the fishable area (see Table 4). These marine reserves areas would provide protection to EFH from disturbances caused by any fishing gear at all times.

EFH-HAPC

With respect to groundfish fisheries that use both mobile and fixed gear, a certain amount of bycatch and unobserved damage and mortality to HAPC biota is expected to occur under FMP 2.1. Management measures that were put into place to protect Steller sea lions close to bottom trawling about 12 percent and 22 percent of fishable area in the BSAI and GOA, respectively. However, these areas are not necessarily closed year-round, do not necessarily incorporate concurrent reductions in TAC, and do not close the areas to fishing with fixed gear. As such, the Steller sea lion closures are likely to benefit EFH (including HAPC) in some areas, but could possibly increase stresses on the habitat elsewhere, and at an unknown rate. In addition, damage to HAPCs by pot and fixed gear is not mitigated by the closures since this type of fishing is not restricted in these areas. Therefore, FMP 2.1 has the potential for moderate to substantial impact in areas with high concentrations of HAPC species. The increase in fishing effort by all gear types is not offset by large, year-round closures, or any TAC reductions throughout the management area. Opening the Pribilof Islands Habitat Conservation Area and Sitka Pinnacles Marine Reserve could have adverse effects on HAPC.

Target and Non-target Species

The environmental consequences of the Alternative 2 policy, as illustrated by FMP 2.1 on target, non-target, prohibited species, marine mammals, and seabirds is not known. The elimination of the existing closed areas (with the exception of those required to protect Steller sea lions) may result in increased impacts to these species. However, unless documented, the Alternative 2 policy presumes there are no significant adverse effects on the environment.

Forage Fish

Under this FMP scenario, many closed areas would be opened, TACs would be raised, and PSC limits would be removed; a higher volume of forage fish could be caught as bycatch in the groundfish fisheries. Although the extent of the effect on forage fish populations is unknown, adverse effects could be realized.

Prohibited Species

Since the closures and catch limits enacted to protect these species from excessive bycatch and habitat destruction would be repealed, prohibited species are likely to experience adverse effects.

Marine Mammals

While the Steller sea lion Protection Measures would remain in place and could provide benefits to other marine mammals, repeal of the prohibited species and other closures could indirectly adversely affect marine mammals.

Seabirds

Since many closed areas would be opened, additional incidental take and vessel strikes could impact seabird mortality. Also, impacts could be realized if forage fish populations are impacted.

Effects on the Social and Economic Environment

Due to the more aggressive harvest strategy of policy Alternative 2, FMP 2.1 would produce socioeconomic effects that are relatively similar among industry sectors (catcher vessel, catcher processor, and inshore processor), fishery, and region. These effects will be quantified and discussed in detail in chapter 4; however, a brief qualitative discussion is provided below.

FMP 2.1 is intended to increase the level of harvest in all fisheries and therefore increase the short-term benefits for fishery participants. All three industry sectors are expected to see improved conditions, at least in the short-term (4-5 years) (NMFS 2001a). Positive impacts related to vessels, catcher processors, and inshore and offshore processors would accrue to all Alaska regions involved in the groundfish fishery: Alaska Peninsula and Aleutian Islands, Kodiak, Southcentral Alaska and Southeast Alaska. Average costs per unit of catch for catcher vessels can be expected to decrease somewhat due to the increase in overall levels of production resulting from higher catches. Because revenues are expected to increase while costs decrease, the percentage increase in profits can be expected to be greater than the increase in revenues; however, quantitative estimates are unavailable at this time (NMFS 2001a).

Under Alternative 2 as illustrated by FMP 2.1, the BSAI and GOA groundfish fisheries are expected to continue to provide high and relatively stable levels of seafood products to domestic and foreign markets. Increases in productivity of several different products could result in lower consumer prices and increased consumer surplus (NMFS 2001a).

Because FMP 2.1 would remove some fishing restrictions in nearshore areas, it would allow vessels to spend more time fishing nearer to shore and would reduce the potential for the risk of accidents and injury due to hazardous weather and other conditions. This could be particularly true in Southeast Alaska where repeal of the LLP would open all of the area east of 144° W longitude to trawling. Other positive impacts would be realized in the Bristol bay area as the Nearshore Bristol bay closures in areas 506 and 512 would be open; along the Aleutian Islands where the Chinook Savings Area, Herring Savings Area, and Red King Crab Closure area would be open; and around Kodiak with the opening of the Kodiak Type 1 and Type 2 Areas.

Conversely, the aggressive strategy illustrated by FMP 2.1 could have a large impact on some species and the environment (NMFS 2001a). It is possible that a large reduction in non-use and non-consumptive values would result.

Effects on the Ecosystem

Under FMP 2.1, the increase in fishing effort and opening of all time/area closures except the Steller sea lion Protection Measures may increase the risk of local and temporal depletions that can be disruptive to ecosystems. The main predator-prey related effects of the FMP illustration would be an increase in short-term harvests of economically desirable species such as pollock (a key prey item) and cod (an important predator). Thus the bookend could provide less protection to pelagic forage ability (NMFS 2001a). Increased catches of pollock could also impact the spatial and/or temporal concentration of prey removals, especially since the Bogoslof area and Donut Hole would be open to fishing. However, since there would be little change in the trophic level of the catch under FMP 2.1 relative to trophic level of biomass, fishing-down effects on the food web would not be realized.

FMP 2.1 could induce an unknown level of decline in species diversity through increased catch levels of target species (NMFS 2001a). These increased catch levels could reduce protection of endangered species that rely on target species for prey. Increased bycatch of potentially sensitive species such as skates, grenadiers, and sharks would occur along with increased mortality of benthic invertebrates and HAPC biota such as corals, sponges, anemones, sea pens, and sea whips. Alternative 2, as illustrated by FMP 2.1, would provide less protection to genetic diversity because it would possibly increase fishing intensity on spawning aggregations (due to opening of closed areas such as the Sequam Pass/Bogoslof Area) and on larger, more heterozygous fish.

Effects on Management and Enforcement

FMP bookend 2.1 eliminates the VMS monitoring system as part of illustrating a less precautionary management policy. As described for Alternative 1, VMS data provide real-time information on vessel location and indicate fishing activity. Without the system, enforcement of Steller sea lion Protection Measures would be difficult. Elimination of the current VMS requirement may have a negative impact on the fishing industry, as it could lead to the closure of all Steller sea lion Critical Habitat to fishing should it be determined by NOAA Fisheries, Office of Protected Resources, that without VMS monitoring the remaining Steller sea lion Protection Measures are no longer effective.

4.3 Overview of EFH/MPA Management Measures of FMP Bookend 2.2

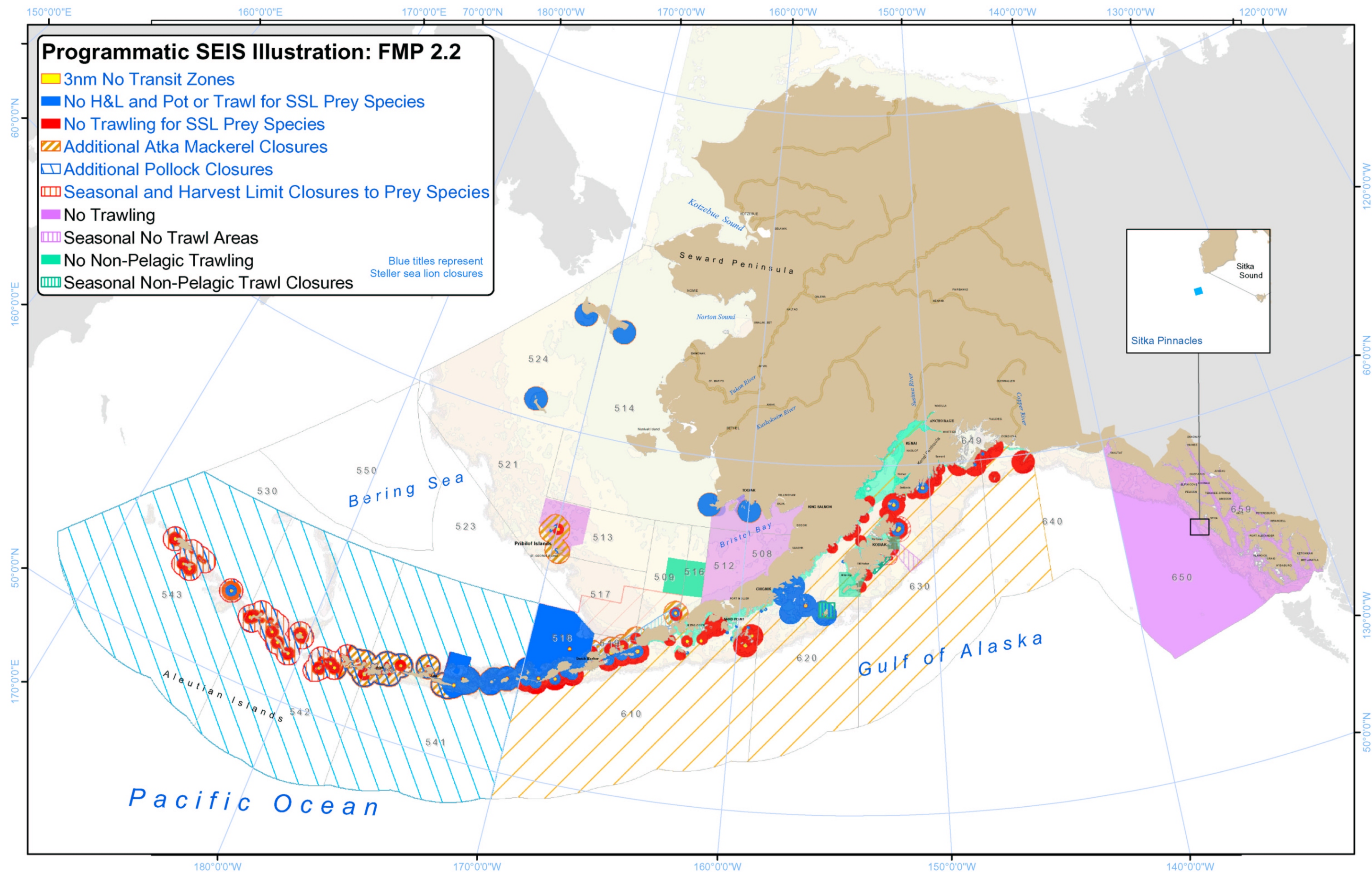
Figure 6 depicts the closure areas for this bookend, while Table 5 provides the descriptive statistics. The FMP 2.2 bookend proposes no change to the existing closure areas as described under the existing FMPs. Therefore, a total of approximately 29 percent of the total FMP area in the BSAI and GOA combined (closures within various subareas range from about 19 percent to 82 percent) is closed to trawling at various times throughout the year.

4.4 Effects of EFH/MPA Management Measures of FMP Bookend 2.2

Impacts of the FMP 2.2 illustration on the physical, biological, and social and economic environments would be the same as under the Alternative 1 FMPs:

- While non-living substrates and features such as boulders, cobbles, and sand waves can be disturbed by bottom trawls (Auster and Langton 1999), in most cases the structural integrity and complexity of the habitat would not be greatly reduced (NMFS 2001a). Therefore, any impacts of FMP 2.2 on the physical environment are expected to be neither beneficial nor adverse (e.g. no significant impact).
- The spatial distribution of the closed areas under the FMP 2.2 may not protect the full range of habitat types in the BSAI and GOA. The primary focus of the closures is protection of crab habitat and Steller sea lion Critical Habitat. These habitats are generally relatively shallow; thus, the closures do not encompass a wide range of habitat types and depths, which would protect a wide range of EFH for species that inhabit deep water. Under FMP 2.2, there is a near absence of year-round closures to all fishing, with no-take marine reserves constituting only 0.3 percent of the fishable area. A higher percentage of no-take marine reserves would provide a wider range of protection of EFH from disturbances caused by all gear at all times.
- Since the closed areas result in greater distances between ports and open fishing grounds and require fishing further offshore, vessels would incur an increased risk of accidents and injury (NMFS 2001b). Smaller catcher vessels based out of the Alaska Peninsula, Aleutian Islands, and Kodiak communities would have to travel further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch, and exposing the vessels to additional risks due to hazardous weather conditions.

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Table 5 Descriptive statistics for closure areas under FMP scenario 2.2

Current 2002 Trawling ^{1, 2, 3, 4, 5}			
	Fishable Area	Sq Meters of Mngt	% of Fishable Area
Aleutian Islands			
No Trawl	105380000000	43357506644	41.1%
No Take Reserve	105380000000	1662800000	1.6%
Total	105380000000	45020306644	42.7%
Bering Sea			
No Trawl and Bogoslof	798870000000	153708738278	19.2%
No Take Reserve	798870000000	567620000	0.1%
Total	798870000000	154276358278	19.3%
Entire BS & AI			
No Trawl	904250000000	197066244922	21.8%
No Take Reserve	904250000000	2230420000	0.2%
Total	904250000000	199296664922	22.0%
Cen \ West Gulf W 144			
No Trawl	265690000000	87906000000	33.1%
No Take Reserve	265690000000	1266300000	0.5%
Total	265690000000	89172300000	33.6%
Eastern Gulf - East of 144			
No Trawl	90509000000	73958000000	81.7%
No Take	90509000000	8304042	0% ⁶
Total	90509000000	73966304042	81.7%
Entire Gulf of Alaska			
No Trawl	356199000000	161864000000	45.4%
No Take Reserve	356199000000	1274604042	0.5%
Total	356199000000	163138604042	45.8%
Totals			
Total No Trawl	1260449000000	358930244922	28.5%
Total No Take	1260449000000	3505024042	0.3%
Total FMP Area	1260449000000	362435268964	28.8%

- 1 Closures include SSL protection measures, ADF&G restrictions, and No Transit Zones.
- 2 For consistency with other PSEIS analysis, closures are cut at the 1,000-meter boundary with the exception of the Bogoslof foraging area and the Aleutian Islands.
- 3 Pelagic and Non-Pelagic Trawl Closures are included.
- 4 The Steller No Transit areas and Sitka Pinnacles account for the No Take Reserves.
- 5 With the complexity for the SSL measures in the A1, for this analysis, SSL Rookeries and Haulouts were buffered at 12.7nm to effectively close 50 percent of critical habitat.
- 6 Sitka Pinnacles - percentage is about 0.01 percent so this number appears as 0 percent

5.0 Alternative 3 – Adopt a More Precautionary Management Policy

5.1 Overview of EFH/MPA Management measures of FMP Bookend 3.1

A goal of the Alternative 3 policy as illustrated by FMP 3.1 is to develop an MPA efficacy methodology including program goals, objectives, and criteria for establishing MPAs and no-take marine reserves. Specifically, the criteria should meet certain objectives:

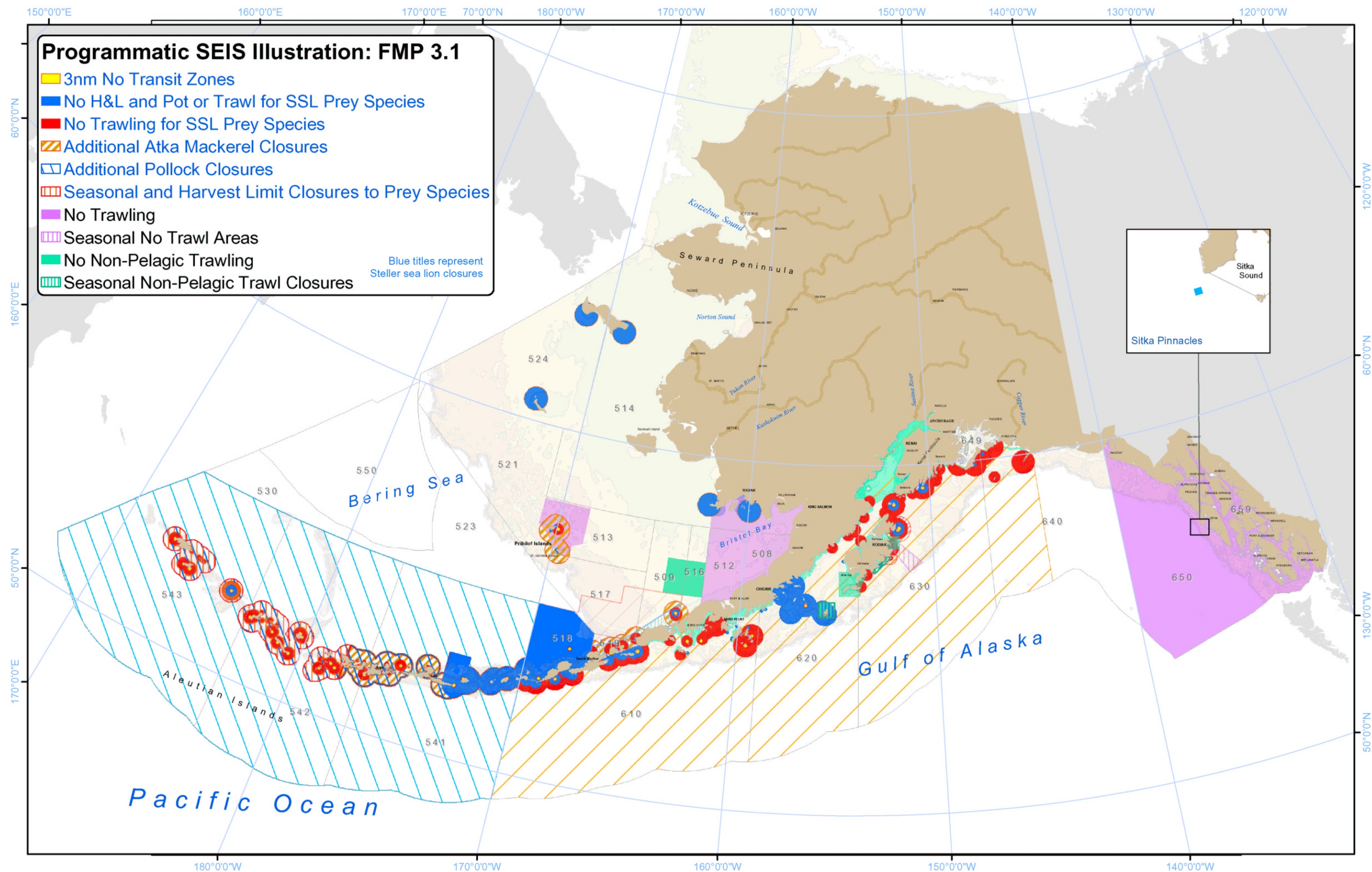
- Consider that MPAs may include no-take areas;
- Review existing closures such as Sitka Pinnacles to see if these areas qualify for MPAs under established criteria;
- Include restrictions of specific gear types or fisheries; and
- Assume that existing closures (see Alternative 1) would remain in effect until the process is complete and MPAs are designated. Figure 7 depicts the closure areas proposed under this scenario and Table 6 provides the descriptive statistics.

Regarding the development of an MPA efficacy methodology, Figures 8 through 10 suggest a three-phase method for the MPA designation process that could be used under this framework. The methodology employs and expands upon EFH/HAPC considerations, the ADF&G (2002) recommendations, and suggestions provided by the NRC (2001). Figure 8 depicts the Phase I design and selection process for establishing an MPA. The goals of this initial phase are to select candidate sites based on the best available science, and to employ early involvement of stakeholders (ADF&G 2002). As shown in the figure, the public, recognized ecological and socioeconomic experts (organized into teams or forums), and interested federal and state agency representatives all have the opportunity to provide input into each step of the candidate selection process. The process follows ADF&G (2002) recommendations and the suggested steps include the following:

1. adopting a policy for MPA designation;
2. developing MPA evaluation criteria; and
3. identifying and evaluating potential sites using the developed criteria.

Phase I ends with the selection of a number of candidate MPA sites, each incorporating one or more of the objectives set at the policy stage.

Phase II, as depicted in Figure 9, advances the MPA designation process and has a goal of designating an MPA site using a process that again maximizes public input and stakeholder concurrence. As in Phase I, public stakeholders, agency representatives, and scientific and socioeconomic experts provide input in the establishment of the candidate MPA boundaries and buffer zones, and are instrumental in the development of management and enforcement plans for the candidate MPA. The final step of the phase is to formally designate the candidate site as an MPA.



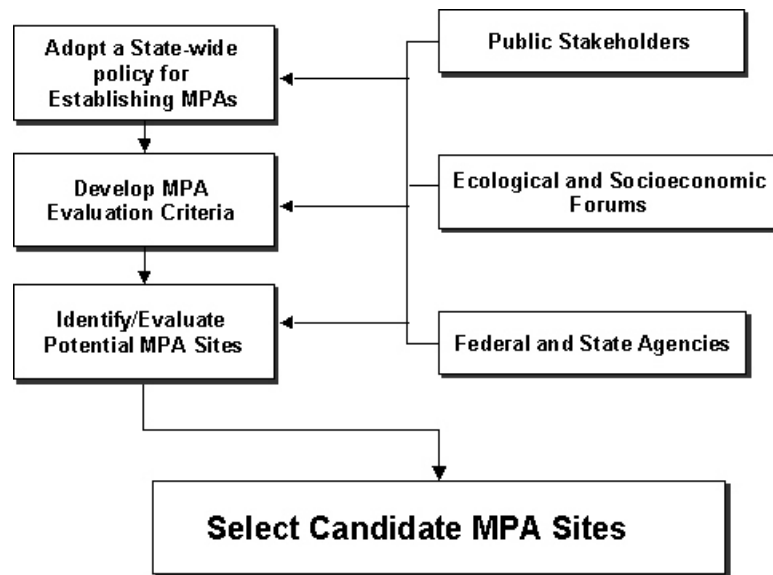
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Table 6 Descriptive statistics for closure areas under FMP scenario 3.1

Current 2002 Trawling Closures^{1 2 3 4 5}			
	Fishable Area	Sq Meters of Mngt	% of Fishable Area
Aleutian Islands			
No Trawl	105380000000	43357506644	41.1%
No Take Reserve	105380000000	1662800000	1.6%
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Bering Sea			
No Trawl and Bogoslof	798870000000	153708738278	19.2%
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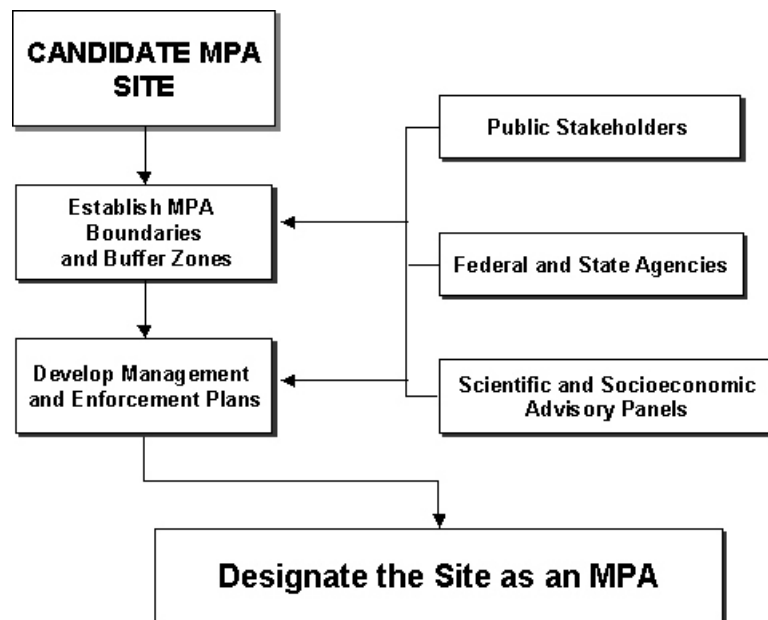
- 1 Closures include SSL protection measures, ADF&G restrictions, and No Transit Zones.
- 2 For consistency with other PSEIS analysis, closures are cut at the 1000-meter boundary with the exception of the Bogoslof foraging area and the Aleutian Islands.
- 3 Pelagic and Non-Pelagic Trawl Closures are included.
- 4 The Steller No Transit areas and Sitka Pinnacles account for the No Take Reserves.
- 5 With the complexity for the SSL measures in the A1, for this analysis, SSL Rookeries and Haulouts were buffered at 12.7nm to effectively close 50 percent of critical habitat.
- 6 Sitka Pinnacles - percentage is about 0.01 percent so this number appears as 0 percent

Goal: Select candidate sites based on best available science and employing early involvement of stakeholders



**Figure 8. Phase I MPA design and selection process. Sources: Marine Protected Areas in Alaska: Recommendations for a Public Process, ADF&G 2002
Marine Protected Areas: Tools for Sustaining Ocean Ecosystems, NRC 2001**

Goal: Designate MPA sites utilizing a process that maximizes public input and stakeholder concurrence



**Figure 9. Phase II MPA design and selection process. Sources: Marine Protected Areas in Alaska: Recommendations for a Public Process, ADF&G 2002
Marine Protected Areas: Tools for Sustaining Ocean Ecosystems, NRC 2001**

Goal: Evaluate MPA effectiveness and allow for changes in management to further advance site objectives

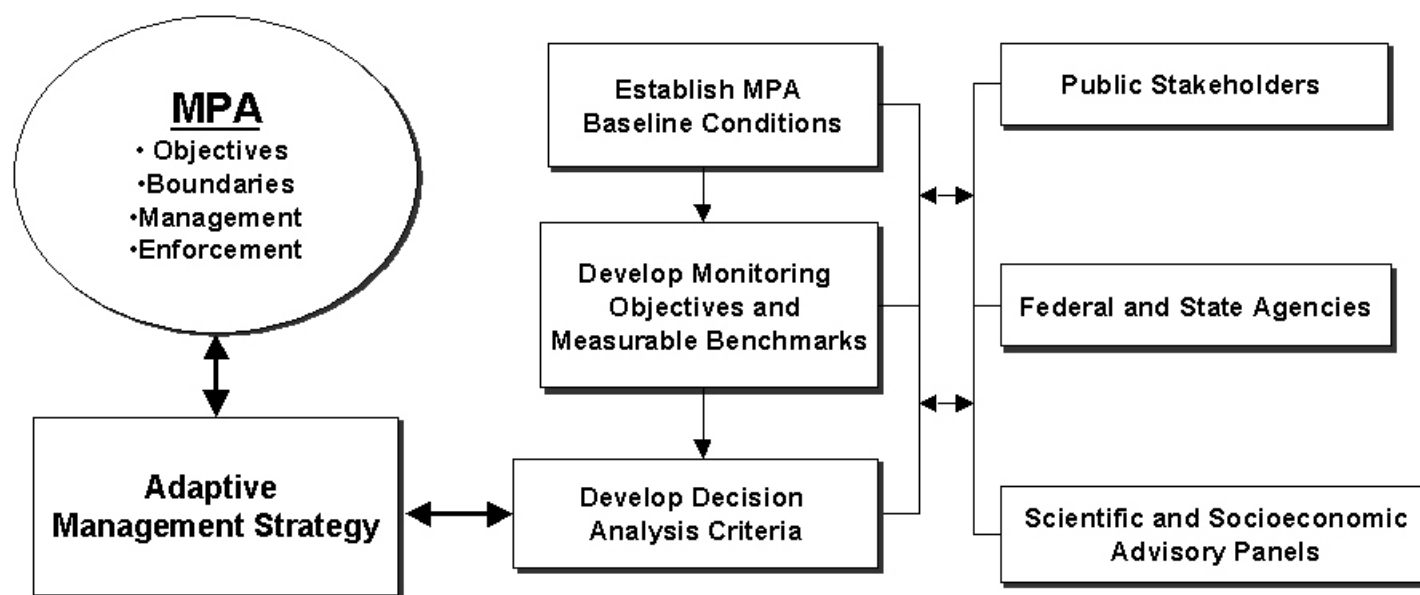


Figure 10. Phase III MPA adaptive management process. Sources: Marine Protected Areas in Alaska: Recommendations for a Public Process, ADF&G 2002 Marine Protected Areas: Tools for Sustaining Ocean Ecosystems, NRC 2001

Phase III (Figure 10) occurs after designation and provides an adaptive process for management of the MPA. The goal is to evaluate the effectiveness of the reserve and allow for changes in management, particularly if site conditions change. Again, the public, federal and state agencies, and experts in the subject matter have an opportunity to provide input throughout all steps in the process. The development of the adaptive management strategy should be viewed as a continuous, reciprocal process, where feedback from the existing strategy is provided to decision makers and stakeholders through an interactive process.

Another goal of Alternative 3, as illustrated by FMP 3.1, is to evaluate the impacts of all gear on habitat through the implementation of a comprehensive research plan. A comprehensive research program would provide data on the following:

- habitat type and structure;
- productivity and biodiversity;
- habitat recovery;
- effects of fishing; and
- effects of other human induced impacts such as pollution.

For example, a research program designed to provide regional shoreline information on habitat type would serve fishery managers and the public well by providing scientific information necessary to produce a regional marine habitat atlas. Such an atlas would allow scientists to more fully evaluate the impacts of fishing on habitat type and determine appropriate mitigation measures.

5.2 Effects of MPA/EFH Management Measures of FMP Bookend 3.1

The impacts of the FMP 3.1 closure areas on the biological, physical, and social and economic environments are the same as those for the current FMPs under Alternative 1:

- While non-living substrates and features such as boulders, cobbles, and sand waves can be disturbed by bottom trawls, in most cases the structural integrity and complexity of the habitat would not be greatly reduced (NMFS 2001a).
- The primary focus of the closures is protection of crab habitat and Steller sea lion Critical Habitat. These habitats are generally relatively shallow; thus, the closures do not encompass a wide range of habitat types and depths. A higher percentage of no-take marine reserves would provide a wider range of protection for EFH from disturbances caused by all gear at all times.
- Since the closed areas result in greater distances between ports and open fishing grounds and require fishing further offshore, vessels would incur an increased risk of accidents and injury.

Should the methodology developed under this FMP illustration provide for additional closures or specific gear restrictions, additional protection for habitat, prohibited species, and marine mammals could be realized.

5.3 Overview of EFH/MPA Management Measures of FMP Bookend 3.2

FMP bookend 3.2 provides an alternative FMP that could be implemented under the Alternative 3 policy. For example, it designates 0 to 20 percent of the BSAI and GOA as no-trawl MPAs and no-take marine reserves (e.g., 5 percent = no-take, 15 percent = no-trawl MPA) across a range of habitat types. The management regime would also designate no-take marine reserves to serve as research control areas; these areas could encompass existing closures. There are many possible permutations of this type of FMP that would vary both MPAs and the establishment of no-take reserves. For analysis purposes, Figure 11 has been developed to provide one illustration of the many scenarios possible under FMP 3.2; Table 7 provides descriptive statistics for the illustration.

As seen in Table 7 and Figure 11, the FMP 3.2 would close 47.8 percent of the fishable area covered by the FMPs in the BSAI and GOA combined. This area would be closed to bottom contact trawling (non-pelagic) or other fishing for at least part of the year. Of this 47.8 percent, 8.2 percent is designated as no-take marine reserves closed to all fishing year-round. As shown in Table 7, bottom contact trawl closures in the GOA total 72 percent of the fishable area at one time or another with almost 14 percent of the fishable area designated as no-take marine reserves. The largest percentage of GOA closures takes place in the Eastern Gulf, where 92.2 percent of the fishable area is closed at one time or another with about 5 percent designated as no-take marine reserves. In the Central and Western Gulf, seasonal and other restrictions close about 66 percent of the fishable area, with about 17 percent designated as no-take marine reserves. Comparatively, nearly 80 percent of the Aleutian Islands is closed to bottom trawling for at least part of the year, with about 19 percent designated as no-take marine reserves. In the Bering Sea nearly 33 percent of the fishable area is closed at one time of year or another to various fishing gears, with about 4 percent designated as no-take marine reserves.

FMP bookend 3.2 breaks out percentages for two additional restricted areas:

- Steller sea lion No-Trawl MPA, where trawling for pollock, Pacific cod, and Atka mackerel (Steller sea lion prey species) is not allowed, but fishing by other methods for these fish, and fishing by all methods for other fish such as rockfish and flatfish is allowed. In the BSAI and GOA, these areas account for about 2 percent and 10 percent of the fishable area, respectively.
- Steller sea lion No Hook-and-Line, Pot, or Trawl MPA, where no fishing by any method is allowed for the sea lion prey species, but fishing by all methods for other species is allowed. These areas comprise nearly 7 percent of the fishable area in the BSAI and nearly 22 percent in the GOA.

Percentages for these closure areas, which are considered MPAs but do not meet the definition of no-take marine reserves, are shown in Table 7.

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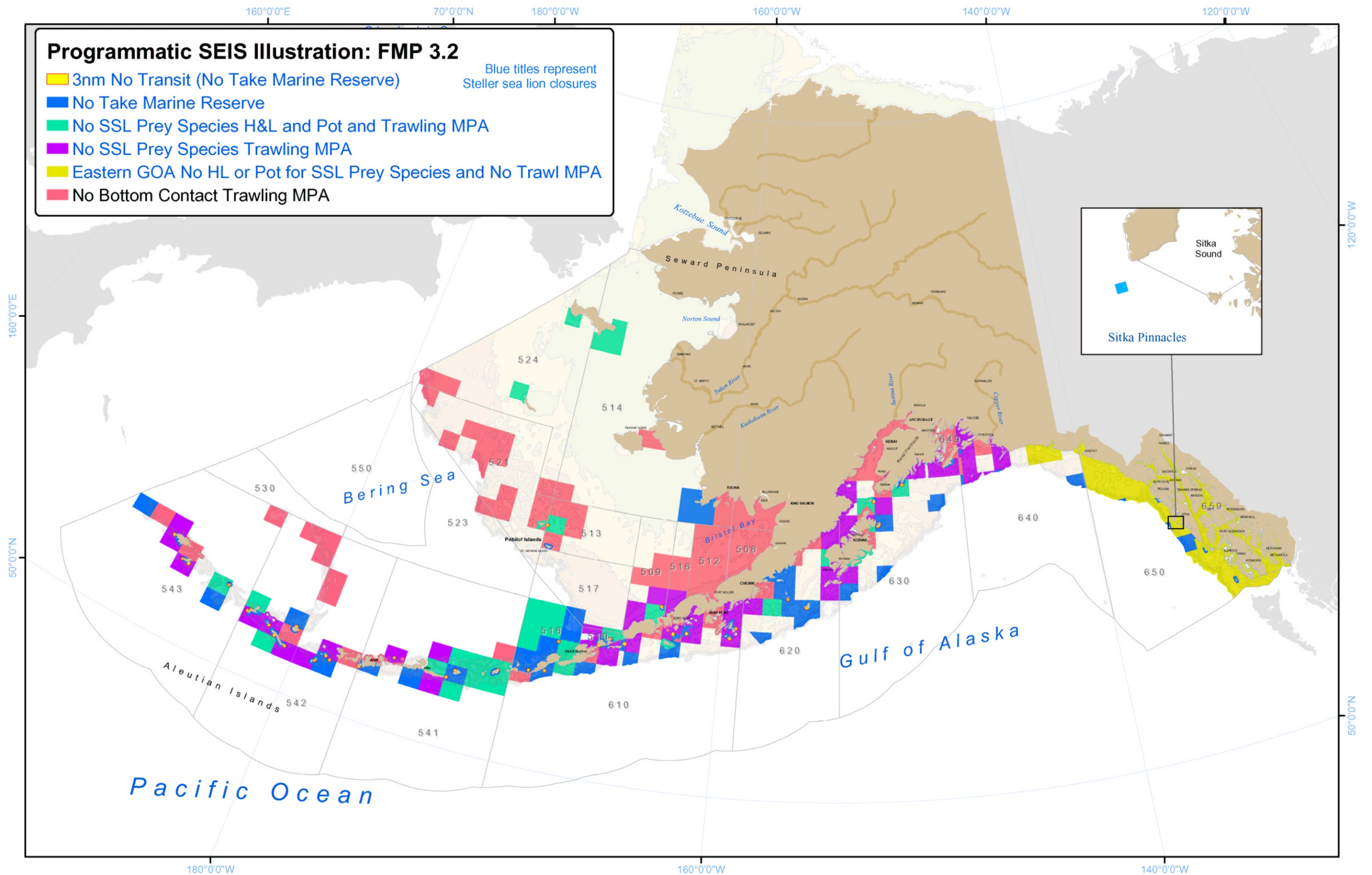


Figure 11. Closure areas for FMP bookend 3.2

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Table 7 Descriptive statistics for closure areas under FMP scenario 3.2^{1 2 3 4}

	Fishable Area	Sq Meter of Mngt Area	% of Fishable Area
Aleutian Islands			
No Trawl MPA	105380000000	37021000000	35.1%
No Take Marine Res	105380000000	20175000000	19.1%
No SSL HL Pot Trawl MPA	105380000000	19345000000	18.4%
No SSL Trawl MPA	105380000000	7650200000	7.3%
Total	105380000000	84166200000	79.9%
Bering Sea			
No Trawl MPA	798870000000	170212365792	21.3%
No Take Marine Res	798870000000	34247800000	4.3%
No SSL HL Pot Trawl MPA	798870000000	41941000000	5.3%
No SSL Trawl MPA	798870000000	14231000000	1.8%
Total	798870000000	260632165792	32.6%
Entire BS & AI			
No Trawl MPA	904250000000	207233365792	22.9%
No Take Marine Res	904250000000	54422800000	6.0%
No SSL HL Pot Trawl MPA	904250000000	61286000000	6.8%
No SSL Trawl MPA	904250000000	21881200000	2.4%
Total	904250000000	344798365792	38.1%
Central \ Western Gulf			
No Trawl MPA	265690000000	82306490050	31.0%
No Take Marine Res	265690000000	44057000000	16.6%
No SSL HL Pot Trawl MPA	265690000000	13529000000	5.1%
No SSL Trawl MPA	265690000000	34410000000	13.0%
Total	265690000000	174302490050	65.6%
Eastern Gulf			
No Trawl MPA	90509000000	15070038000	16.7%
No Take Marine Res	90509000000	4811664379	5.3%
No SSL H&I Pot Trawl	90509000000	63602319644	70.3%
Total	90509000000	83484022023	92.2%
Entire Gulf of Alaska			
No Trawl MPA	356199000000	97376528050	27.3%
No Take Marine Res	356199000000	48868664379	13.7%
No SSL HL Pot Trawl MPA	356199000000	77131319644	21.7%
No SSL Trawl MPA	356199000000	34410000000	9.7%
Total	356199000000	257786512072	72.4%
Total No Take	1260449000000	103291464379	8.2%
Total	1260449000000	602584877865	47.8%

- 1 Some areas extend past the shelf and since the fishable area is based on the shelf, analysis does not represent total fishable area closed.
- 2 The management areas are cut at the 1,000 meter shelf break but for clarity the AI closures are shown in total.
- 3 Bering Sea areas have been cut by the 1,000 meter bathymetry but the Bogoslof Foraging and small surrounding areas are included in management areas.
- 4 Since the Eastern Gulf does not contain SSL Protection Measures, combined GOA area calculations must be read carefully.

5.4 Effects of EFH/MPA Management Measures of Bookend 3.2

Effects on the Physical Environment

As described under Alternative 1 and FMP 3.1, the existing closure areas in the BSAI and GOA approach 20 percent coverage of the fishable area. However, the FMP 3.1 (existing) closures are not necessarily year-round and may not restrict all gear and protect all habitat types. The FMP 3.2 bookend illustrates a different management regime where an MPA program is established with a minimum amount of the fishable area designated either as a no-trawl or no-bottom contact MPA or a no-take reserve. It is predicted that there would be fewer impacts on the substrate under this regime, since more area would be closed to bottom contact, and a greater percentage of fishable area would be designated as no-take marine reserves.

Effects on the Biological Environment

EFH - Benthic Biodiversity

This FMP scenario has the potential for increased protection for EFH since it strives to protect a broader range of habitats, substrates, and depths. At present, much of the closed areas is used to protect prohibited species such as crab and halibut, or for sea lion critical habitat. Many of these areas require only seasonal closures or closures only when certain bycatch triggers are reached.

Under the Alternative 3 policy, no-take marine reserves could be established across a broad range of habitat types and water depths. These reserves would prohibit all commercial groundfish fishing year-round. FMP Bookend 3.2 illustrates one application where, in addition to no-take reserves, 47.8 percent of the fishable area would be closed to bottom trawling and or other gear for at least part of the year. Of this percentage, 8.2 percent is designated as no-take marine reserves. While the existing closures total about 29 percent of fishable area in the GOA and BSAI combined (see Table 2), which is more than the actual percentage defined by the Alternative 3 policy, these closures are generally trawl limitations enacted to protect specific prohibited species and Steller sea lions rather than broadly protecting EFH. The existing FMP designates less than 1 percent of the fishable area as no-take reserves. Therefore, the more-focused, year-round closures recommended under FMP 3.2 are likely to benefit EFH by offering protection to a larger portion of the continental shelf compared to FMP 3.1, and by decreasing bottom contact from all gear types.

EFH - HAPC

As shown in Figure 11 and Table 7, FMP 3.2 illustrates an FMP where additional closure areas are used in the deeper waters that encompass the outer continental shelf and upper slope of the central and western GOA and BSAI. These deep water areas contain bottom features that have been found to be associated with juvenile rockfish. The Aleutian Islands region, in particular, is an area with high habitat complexity and high abundance and diversity of coral species (Heifetz 2002). This area would receive considerable protection under FMP 3.2.

Bottom trawl closures are, in many cases, not year-round and do not restrict fixed gear use under FMP 3.1 as well as under the current FMPs (Alternative 1). In some cases, scientific studies have shown that fixed-gear adversely impacts HAPC. Some specific geographic areas with sensitive habitat (e.g., gorgonian corals) are probably the most susceptible to fixed-gear impacts. Under FMP 3.2, there would be additional

areas closed to all fishing year-round compared to FMP 3.1. These no-take marine reserves would provide protection of HAPC from disturbances caused by all gear at all times. While this FMP bookend still provides potential for moderate-to-substantial trawling effort in areas with high concentrations of HAPC species, the effects of disturbance to HAPC are offset in this FMP by year-round closures to all fishing across a broad range of habitats, along with reductions in TAC, so fishing effort does not merely move to and concentrate in another, possibly sensitive, area.

Target, Non-Target, Forage Fish, and Prohibited Species

Under the FMP bookend 3.2 the existing closure areas in the BSAI and GOA that generally have been designated to protect various prohibited species would remain in place and would be supplemented by additional no-trawl MPAs and no-take marine reserves. These closures may indirectly provide benefits to target and non-target species by protecting juveniles and important habitat. The use of additional, year-round no-take marine reserves could likely also provide benefits to prohibited species and forage fish.

Marine Mammals

The additional no-take marine reserves defined by FMP 3.2 would benefit marine mammals by lessening direct impacts (mortality, direct disturbance) and indirect impacts (loss of prey).

Seabirds

None of the closure areas currently in place are specifically designed to protect or enhance seabird populations. However, the additional near-shore closures proposed under FMP 3.2 may directly benefit seabirds by reducing the incidence of direct mortality due to seabird/vessel collisions and inadvertent take of seabirds by fishing vessels. Also any beneficial effects for this FMP on forage fish could indirectly benefit seabirds. Additional discussions on the impacts of this scenario on seabirds are found in the Seabird Qualitative Impact Assessment (see Appendix F-6).

Effects on the Social and Economic Environment

Under policy Alternative 3 as illustrated by FMP 3.2, average costs per unit of catch for catcher vessels can be expected to increase (NMFS 2001a). Spatial displacement of fishing effort due to the extensive closure areas could lead to increased operating costs for vessels. The spatial displacement of fishing effort would be large for some bottom trawl fisheries. Operating costs would be increased as vessels travel further to harvest fish and may be required to fish in less productive areas in some cases.

It is reasonable to assume that, subject to regulatory constraints, harvesters target catch with the gear that maximizes its value either by increasing the quality of the fish or by decreasing the harvesting costs, or both. Therefore, the replacement of several bottom trawl fisheries with pelagic trawl and fixed-gear fisheries would result in an increase in cost per unit of catch. Preemption of some fishery sectors is possible as catch is shifted toward larger vessels and the plants to which they deliver fish (NMFS 2001a).

Alternative 3 as illustrated by FMP 3.2 could produce impacts beyond reducing profits in the harvest and processing sectors. Reductions in production of several different products could result in higher prices and

a loss of consumer surplus to the American public; however, individual effects could be mitigated by increased production of other seafood products.

As compared to FMP 3.1 and Alternative 1 (existing closures under the current FMPs), the closed areas result in possibly greater distances between ports and open fishing grounds and require fishing even further offshore. Smaller catcher vessels based out of the Alaska Peninsula, Aleutian Islands, and Kodiak communities would have to travel further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch, and exposing the vessels to additional risks due to hazardous weather conditions. Therefore, the closures would favor larger vessels over small. These effects could be mitigated somewhat if Individual Fishing Quotas (IFQs) for local fishermen were allowed in certain nearshore areas.

Positive impacts of the policy Alternative 3 closures as illustrated by FMP 3.2 include benefits to non-market issues such as existence values and eco-tourism. While estimates of non-consumptive and non-use values for various levels of the BSAI and GOA ecosystems are not available, it can be assumed that the closures under the existing FMPs serve to enhance these values to an unknown extent. Since the closures illustrated under FMP 3.2 provide additional protection to habitat, an additional benefit above that achieved from the status quo is assumed.

Effects on the Ecosystem

The FMP 3.2 illustration could change predator-prey relationships by providing additional areas that would be totally closed to fishing. The no-take marine reserves would provide areas where prey populations would not be disturbed and could therefore benefit predators (NMFS 2001a). Reducing the disturbance of benthic prey through bottom trawling would provide a less disturbed prey base for benthic feeding animals. Scavenging animals that presently benefit to some degree from trawls that expose benthic prey would experience a decline; however, the actual magnitude of the positive benefits to non-scavenging predators is not known. Changing the selectivity toward gear that removes older fish would reduce energy flow at higher trophic levels which would shorten the food chain and decrease the lifespan of organisms. However, since there would be little change in the trophic level of the catch under FMP 3.2 relative to trophic level of biomass, fishing-down effects on the food web is not predicted.

FMP 3.2 could provide an unknown level of protection for species-level diversity since many benthic invertebrates that are vulnerable to high levels of mortality through gear impacts would be protected. The policy alternative, as illustrated by FMP 3.2, would provide additional protection to benthic trophic guilds that supply prey to many groundfish species (NMFS 2001a).

Effects on Management and Enforcement

The requirement that all vessels participating in the Atka mackerel, Pacific cod, or pollock directed fisheries carry an operable, approved VMS transmitter would continue under the FMP 3.2 bookend. VMS data provide real-time information on vessel location and indicate fishing activity and would be essential for enforcement under this bookend, which incorporates a complicated patchwork of closure areas and seasonality. The VMS reporting system is discussed further in the Data and Reporting Requirements Qualitative Impact Assessment.

The Observer Program, which is also discussed in detail in a separate paper, would also continue under this bookend and would be extended to include 100 percent of vessels over 60 ft. The additional coverage would help to ensure that these larger vessels are not fishing in closed areas.

6.0 Alternative 4 – Adopt a Highly Precautionary Management Policy

6.1 Overview of EFH/MPA Management Measures of FMP Bookend 4.1

This FMP component illustrates a plan that designates 20 to 50 percent of the management area as no-take reserves covering the full range of marine habitats. The emphasis is on closing areas where impacts of fishing are unknown due to insufficient data. Additional areas could be opened when information is available to show no or negligible impacts from fishing. There are many possible ways to apply a 20 to 50 percent rule. Each would vary the location and geographical extent of the seasonal closure areas and no-take reserves. For analysis purposes, Figures 12 and 13 depict one possible application for the Alternative 4 policy as described by FMP 4.1. Figure 12 depicts the closures in a monochromatic scheme in order to emphasize the total area closed and the concept that all areas are closed (purple) until available information regarding impacts allows them to join areas which are already open to fishing (white). Figure 13 depicts the closure areas in colors compatible with the figures depicting the other alternative scenarios.

Table 8 also provides the descriptive statistics for the FMP 4.1 illustration. As shown, this FMP scenario would close 51.1 percent of the fishable area in the BSAI and GOA combined to trawling for at least part of the year. Under this illustration, in the combined BSAI and GOA 28.5 percent of fishable area would be designated as no-take marine reserves, closed to all fishing year-round. In the BSAI nearly 40 percent of the fishable area would be closed to trawling at some point during the year, with about 25 percent designated as no-take marine reserves. The majority of the closed areas would occur in the GOA where just over 80 percent of the fishable area would be closed to trawling at one time or another. This is due to the relatively limited continental shelf and slope in the GOA, and the higher abundance of vulnerable habitat in that region. No-take marine reserves covering about 38 percent of the fishable area would be designated in the GOA.

6.2 Effects of EFH/MPA Management Measures of FMP Bookend 4.1

Effects on the Physical Environment

As described above, the existing closure areas in the BSAI and GOA approach 30 percent coverage of the fishable area (e.g., continental shelf and slope to 1,000 m water depth) (See Table 2.) However, the existing closures are not necessarily year-round and may not include all gear and habitat types. FMP 4.1 would close additional, deeper areas to trawling and establishes a higher percentage of no-take marine reserves. Therefore, benthic substrates across a wide range of depths and habitats should be protected from impacts due to bottom contact gear.

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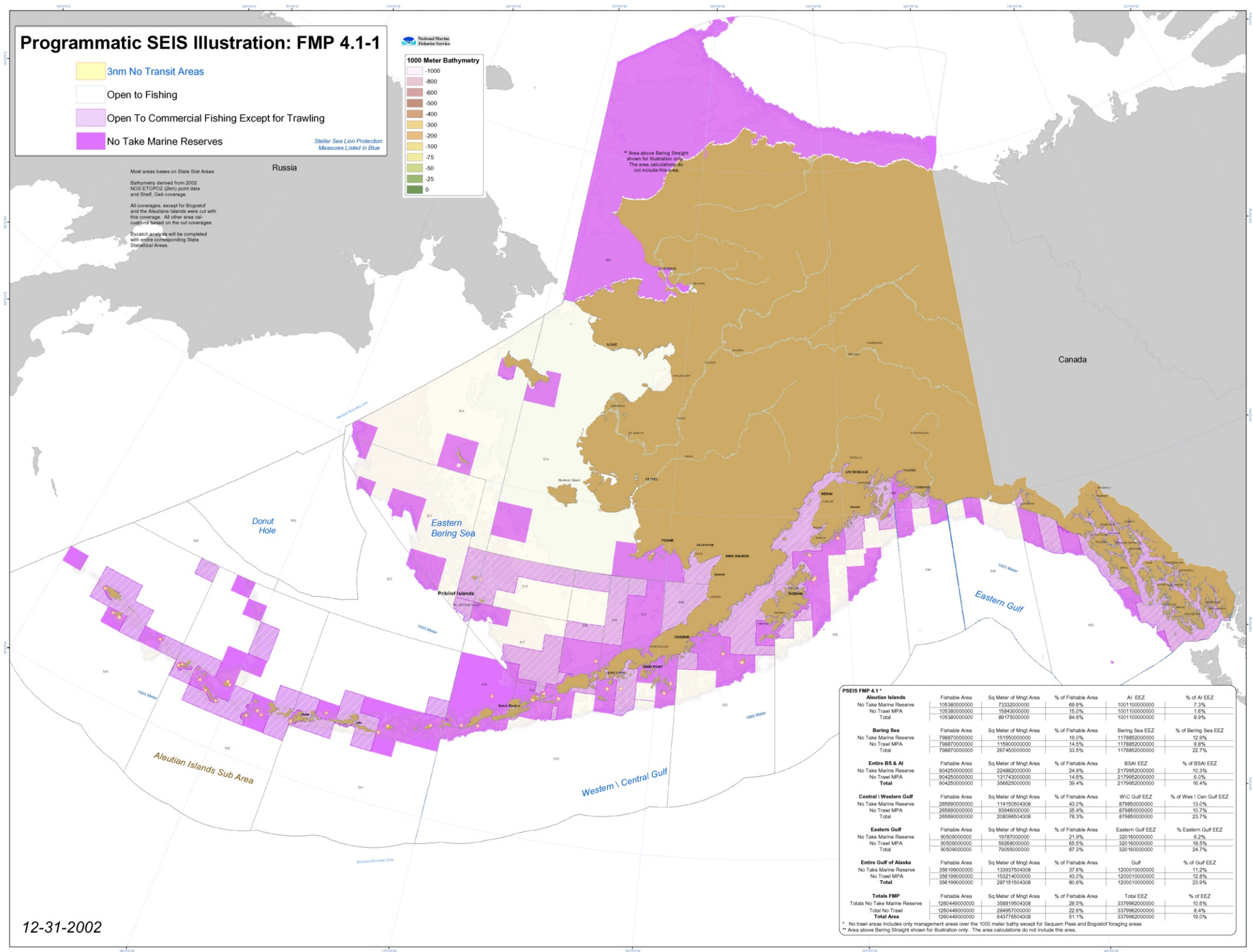


Figure 12. Closure areas for FMP bookend 4.1-1

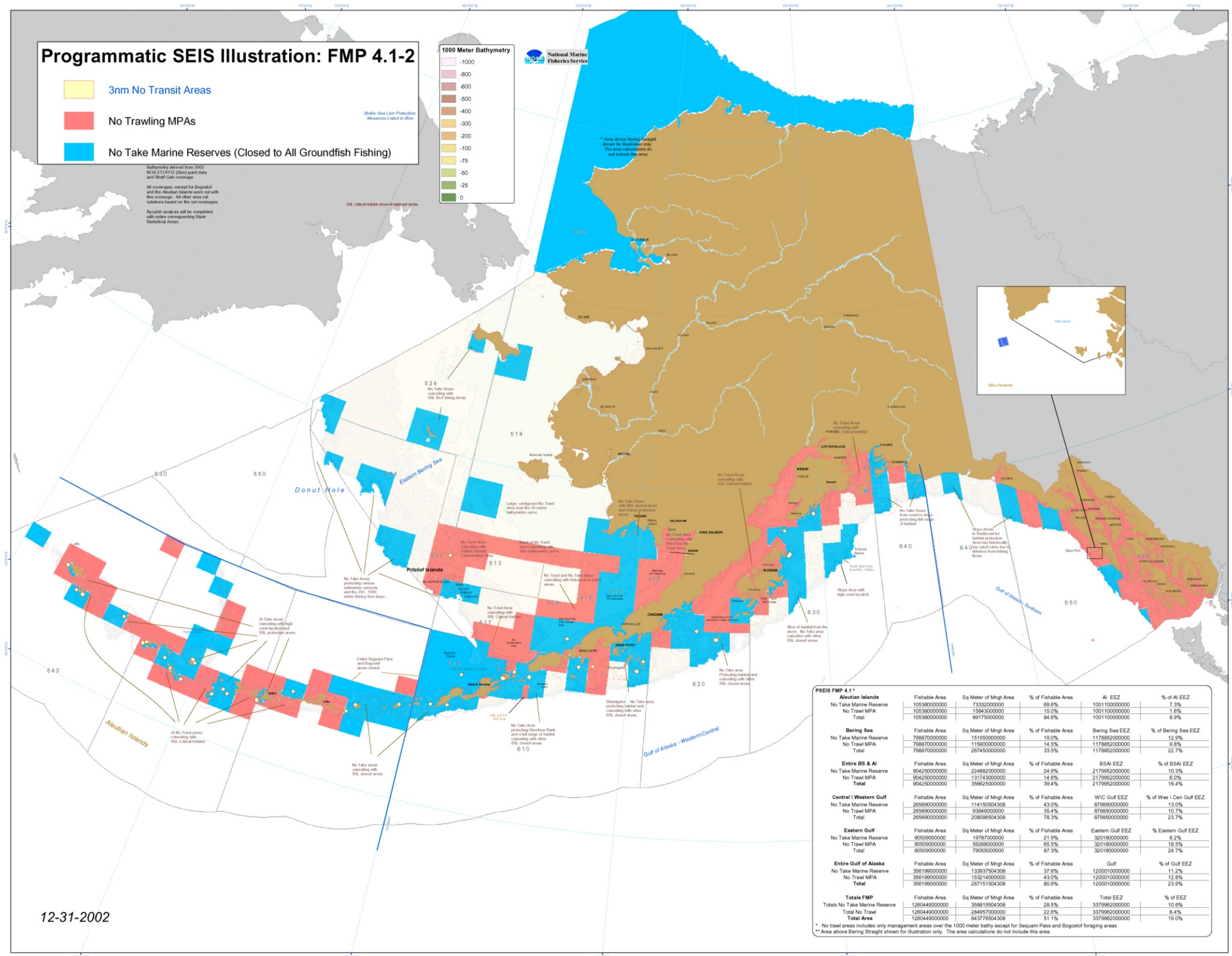


Figure 13. Closure areas for FMP bookend 4.1-2

Table 8 Descriptive statistics for closure areas under FMP scenario 4.1

	Fishable Area	Square Meter of Management Area	% of Fishable Area
Aleutian Islands			
No Take Marine Reserve	105380000000	73332000000	69.6%
No Trawl MPA	105380000000	15843000000	15.0%
Total	105380000000	89175000000	84.6%
Bering Sea			
No Take Marine Reserve	798870000000	151550000000	19.0%
No Trawl MPA	798870000000	115900000000	14.5%
Total	798870000000	267450000000	33.5%
Entire BS & AI			
No Take Marine Reserve	904250000000	224882000000	24.9%
No Trawl MPA	904250000000	131743000000	14.6%
Total	904250000000	356625000000	39.4%
Central \ Western Gulf			
No Take Marine Reserve	265690000000	114150504308	43.0%
No Trawl MPA	265690000000	93946000000	35.4%
Total	265690000000	208096504308	78.3%
Eastern Gulf			
No Take Marine Reserve	905090000000	197870000000	21.9%
No Trawl MPA	905090000000	592680000000	65.5%
Total	905090000000	790550000000	87.3%
Entire Gulf of Alaska			
No Take Marine Reserve	356199000000	133937504308	37.6%
No Trawl MPA	356199000000	153214000000	43.0%
Total	356199000000	287151504308	80.6%
Totals FMP			
Totals No Take Marine Reserve	1260449000000	358819504308	28.5%
Total No Trawl	1260449000000	284957000000	22.6%
Total Area	1260449000000	643776504308	51.1%

* No trawl areas include only management areas over the 1,000-meter bathymetry, except for Sequam Pass and Bogoslof foraging areas

Effects on the Biological Environment

EFH - Benthic Biodiversity

As with FMP ,3.2 this FMP bookend has the potential for additional benefits to accrue to benthic organisms (biodiversity) and EFH, especially since a broad range of habitats, substrates, and depths are protected (see Figure 10). The illustrated closures are more extensive and more focused than current management regimes. FMP 4.1 would close nearly 29 percent of the fishable area to all fishing on a year-round basis. In addition, the concept that areas be closed until adequate information regarding impacts can be collected to determine whether areas should be opened constitutes a paradigm shift in the way the groundfish fishery has been

managed. The extensive designation of no-take marine reserves, along with the change in management concept, is likely to greatly benefit EFH by expanding the amount of benthic areas closed to bottom contact gear.

EFH - HAPC

As shown on Figure 13 and Table 8, FMP 4.1 provides for additional closure areas in the deeper waters of the outer continental shelf and upper slope of the central and western GOA and BSAI. The Aleutian Islands region, in particular, is an area with high habitat complexity and high abundance and diversity of coral species (Heifetz 2002).

The existing closures to bottom trawling are in many cases not year-round, and do not restrict fixed gear use. In some cases, fixed-gear may adversely impact HAPC. Some specific geographic areas with sensitive habitat (e.g., gorgonian corals) are probably the most susceptible to fixed-gear impacts. FMP 4.1 provides for additional closure areas in deeper waters of the outer continental shelf and upper slope. Many of these areas encompass high habitat complexity and high abundance of HAPC. There would be extensive areas closed to all fishing year-round. These no-take marine reserves would provide protection to HAPC from disturbances caused by the groundfish fishery. Under this bookend there is minimal potential for substantial trawling efforts in areas with high concentrations of HAPC species, and along with fishery-specific reductions in TAC, fishing effort is unlikely to move to and concentrate in another area. These combinations of effects will likely benefit HAPC in the BSAI and GOA under this bookend.

Target, Non-Target, Forage Fish, and Prohibited Species

Under FMP bookend 4.1, the closure areas in place in the BSAI and GOA that have been designated to protect various prohibited species would continue. These closures may also provide indirect benefits to target, non-target, and forage fish species. Additional year-round no-take reserves defined by FMP 4.1 will likely provide additional benefits to these species. The existing low volume of incidental catch of forage fish currently observed under the existing FMPs could go even lower under FMP 4.1 due to the extensive closures and reduction in TACs.

Marine Mammals

The additional no-take reserves, as illustrated by FMP 4.1, would likely benefit marine mammals by lessening direct (mortality, direct disturbance) and indirect (loss of prey) effects caused by the groundfish fishery.

Seabirds

None of the closure areas currently in place is specifically designed to protect or enhance seabird populations. However, the additional near-shore closures proposed under FMP 4.1 may directly benefit seabirds by reducing the incidence of direct mortality due to seabird/vessel collisions and inadvertent take of seabirds by fishing vessels. Also any beneficial effects for this FMP on forage fish could indirectly benefit seabirds. Additional discussions on the impacts of this scenario on seabirds are found in the Seabird Qualitative Impact Assessment (see Appendix F-6).

Effects on the Social and Economic Environment

Policy Alternative 4 as illustrated by FMP 4.1 closes large areas of the BSAI and GOA to groundfish fishing. The closures would produce socioeconomic effects that vary by industry sector (catcher vessel, catcher processor, and inshore processor), fishery, and region. While these effects are quantified and discussed in detail in Chapter 4 of the Programmatic SEIS, a brief qualitative discussion is provided herein.

Due to longer transit times to reach open areas, the closures illustrated under FMP 4.1 decrease catch and increase the cost of harvesting a given amount of fish. As described for FMP 3.2, the extensive closure areas would lead to spatial displacement of fishing effort. The spatial displacement of fishing effort would be large for some bottom trawl fisheries. Operating costs would be increased as vessels travel further to harvest fish and may be required to fish in less productive areas in some cases. Under the illustration, average costs per unit of catch would be expected to rise dramatically while fixed costs (e.g., general office and accounting costs, vessel maintenance, and insurance) would be spread over a much smaller total catch (NMFS 2001a). However, the major reductions in catches should also result in increasing abundance of the affected fish stocks, which might eventually tend to increase catch rates. The greatest impact would be on trawl and pot catcher vessels, but hook-and-line catcher vessels would also be subject to substantially increased costs per unit of catch.

Trawl catcher vessels less than 60 ft would likely be the hardest hit by the closures illustrated under FMP 4.1. These vessels, which because of their size fish almost exclusively in nearshore waters in the GOA, would lose a substantial amount of groundfish revenue (NMFS 2001a). Because the open areas are farther from shore than the areas typically fished by trawl catcher vessels less than 60 ft, it is likely that they will not be able to fish at the same relative level as in the past. Even though these vessels are relatively diversified between groundfish and non-groundfish, their reliance on pollock and Pacific cod in the GOA makes them vulnerable to the closures and other components of the FMP 4.1 bookend.

The closures illustrated under FMP 4.1 result in greater distances between ports and open fishing grounds and require fishing further offshore. Smaller catcher vessels based out of the Alaska Peninsula, Aleutian Islands, and Kodiak communities would have to travel further to fish, requiring more time, incurring more costs, potentially reducing the quality of the catch, and exposing the vessels to additional risks due to hazardous weather conditions. These effects could be mitigated somewhat if IFQs for local fishermen were allowed in certain nearshore areas.

Variable costs for inshore processors and motherships are also likely to increase. The total average costs per unit of production would rise, and it is possible that they would exceed the value of production and lead to a shutdown or permanent closing of some processing plants, motherships, and catcher/processors.

Alternative 4 as illustrated by FMP 4.1 would produce impacts beyond reducing profits in the harvest and processing sectors. Reductions in production of several different products would result in significant decreases in supply of groundfish to the domestic market. The supply of surimi for the domestic market and other products might also be reduced. This would result in higher prices and a loss of consumer surplus to the American public.

Positive impacts of the Alternative 4 closures as illustrated by FMP 4.1 include benefits to non-market issues such as existence values and eco-tourism. While estimates of non-consumptive and non-use values for

various levels of the BSAI and GOA ecosystems are not available, it can be assumed that the closures under the existing FMPs would serve to enhance these values to an unknown extent. Since the closures illustrated under FMP 4.1 provide extensive protection to habitat, an additional benefit above that achieved from the status quo and FMP 3.2 could be assumed.

Effects on the Ecosystem

As described above for the FMP 3.2 bookend, the extensive seasonal closures and no-take areas proposed under FMP 4.1 will benefit a wide range of habitats. While the percentages of shelf/slope afforded some level of protection are similar between FMPs 4.1 and 3.2, FMP 4.1 establishes more of the shelf/slope as no-take marine reserve. FMP 3.2 has most of the protected areas in MPAs (trawl restrictions). The no-take marine reserves would provide areas where prey populations would not be disturbed and could therefore benefit predators (NMFS 2001a). Reducing the disturbance of benthic prey through bottom trawling would provide a less disturbed prey base for benthic feeding animals. Also, habitat in the no-take marine reserves would be protected from continuing impacts and could recover from past fishing-related disturbances. The potential benefits of such closures include protection of ecosystem structure across the food web.

FMP 4.1 would provide an additional level of protection over FMP 3.2 for species-level diversity since many benthic invertebrates that are vulnerable to high levels of mortality through gear impacts would be protected. Therefore the policy alternative, as illustrated by FMP 4.1, would provide additional protection to benthic trophic guilds that supply prey to many groundfish species (NMFS 2001a).

Effects on Management and Enforcement

The 4.1 bookend requires that all groundfish vessels carry an operable, approved VMS transmitter. This FMP scenario would expand the existing VMS requirements that mandate the system in the pollock, Pacific cod, and Atka mackerel fisheries by requiring all groundfish vessels to use VMS. VMS data provide real-time information on vessel location and indicate fishing activity and are essential for enforcement under this FMP. The VMS reporting system is discussed further in the Data and Reporting Requirements Qualitative Impacts Analysis (see Appendix F-11).

6.3 Overview of EFH/MPA Management Measures of FMP Bookend 4.2

The FMP 4.2 bookend establishes initial closure areas at 100 percent (i.e., no fishing). Areas could be open to specific fisheries only after review and certification that the fishery would have no significant adverse impacts on the environment. This FMP would require use of scientific information to determine what revisions might be appropriate to mitigate any adverse effects. Figure 14 and Table 9 illustrate a no-fishing scenario until fisheries are certified and issued fishery-specific regulations.

6.4 Effects of EFH/MPA Management Measures of FMP Bookend 4.2

Effects on the Physical Environment

Under this scenario, there would be no negative impacts from fishing on the physical environment in the short-term (up to 2 years), while the Alaska groundfish fisheries undergo the formal review and certification process.

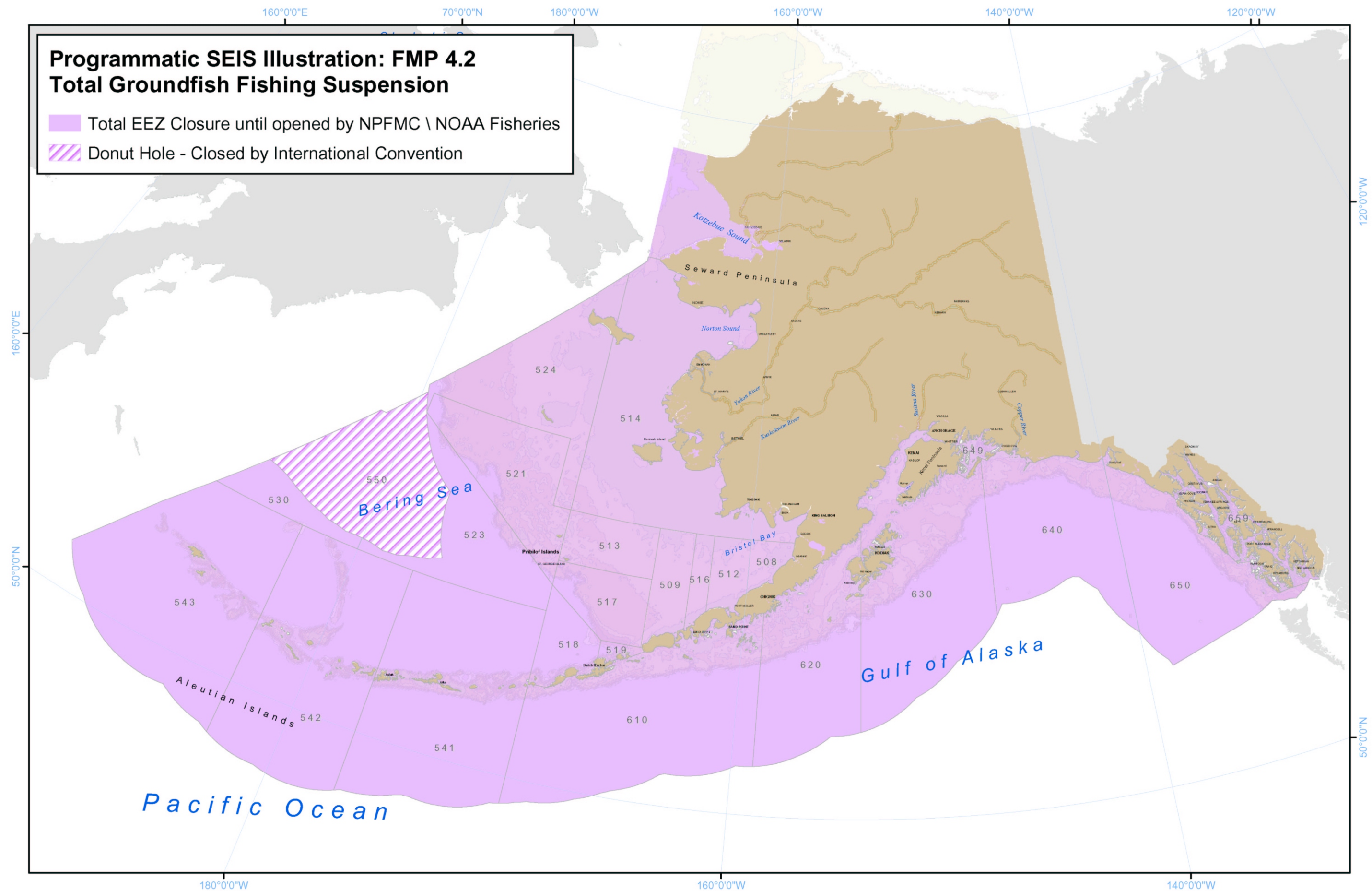


Figure 14. Closure areas for FMP bookend 4.2

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Table 9 Descriptive statistics for closure areas under FMP scenario 4.2

	Fishable Area	No Take Marine Reserve	% of Fishable Area
Aleutian Islands			
No Take Marine Reserve	105380000000	1001100000000	100.0%
Bering Sea			
No Take Marine Reserve	798870000000	1178852000000	100.0%
Entire BS & AI			
No Take Marine Reserve	904250000000	2179952000000	100.0%
Central \ Western Gulf W 144			
No Take Marine Reserve	265690000000	879850000000	100.0%
Eastern Gulf - East of 144			
No Take Marine Reserve	90509000000	320160000000	100.0%
Entire Gulf of Alaska			
No Take Marine Reserve	356199000000	1200010000000	100.0%
Total FMP			
Total No Take Area - Fishable	1260449000000	3379962000000	100.0%
Total No Take Area - EEZ	1260449000000	3379962000000	100.0%

Effects on the Biological Environment and Ecosystem

There would be no negative impacts on the biological environment during the short-term, if all groundfish fishing were suspended until review and certification. Indeed, benthic EFH and HAPC would likely benefit due to the complete removal of physical disturbance from fishery activities, and areas previously damaged from fishing activity could begin to recover. Also, there would be no bycatch of prohibited species. However, as areas are certified and open to groundfish fishing, minimal (not significant) environmental effects could be realized. The process of certification and development of fishery-specific regulations cannot be predicted; therefore, we cannot predict which areas and fisheries may be opened first or to what extent. However, since the fisheries would be slowly reinstated and regulated in a very precautionary manner, it is likely that biological and ecosystem effects would be less than those discussed above for the closures as illustrated by FMP 4.1.

Effects on the Social and Economic Environment

The impact of the initial FMP 4.2 scenario (no fishing) on the Alaska economy and on the economy of the United States would be severe. Catcher vessels would be shut down unless they could fish for species not managed under the groundfish FMPs (e.g., state fisheries, areas outside the U.S. EEZ).

Catcher/processors and Inshore processors would be negatively affected. For example, Dutch Harbor/Unalaska was ranked number one both in volume and value of fish landed in the nation for 1992 through 1996 and has netted the top landings spot for 13 consecutive years. Commercial fishermen brought 834.5 million pounds of fish to the port of Dutch Harbor-Unalaska, Alaska, in 2001, making it the port with the highest volume of fish landings in the country. This port was second in the United States in commercial fishery value for 2000 and 2001 with \$146 and \$151 million, respectively. The Port of Dutch Harbor

strongly supports the commercial fishing industry, providing moorage and offering complete fleet services. Kodiak, Alaska, was the 6th ranked port in commercial fishery landings in both 2000 and 2001 (290 and 286 million pounds of fish, respectively) and was third in fishery value for each of those years (\$98 and \$74 million each year, respectively). Revenue from landings at Kodiak and Dutch Harbor and the associated support services would disappear under the no fishing scenario.

These effects would prevail until each Alaska groundfish fishery was subjected to an environmental review and, if the results of that review allowed, permitted to operate under strict guidelines. Only fisheries certified by NOAA Fisheries to have no significant adverse effects on the environment would be authorized to operate in the EEZ off Alaska. Such a review and certification process would likely take up to two years based on the length of a recent environmental review of the Alaska pollock fishery conducted by an international organization. Since it is not possible to predict the time-line and extent of certification, it is not possible to predict the overall extent of the economic and social effects. It is likely that the regulations to operate the certified fisheries would be more restrictive, at least for some time, than those illustrated under FMP 4.1. Therefore, it is likely that the social and economic impacts would be more severe than those described above for FMP 4.1, until such time that the certified fisheries and their specific regulations equaled or exceeded the illustration provided under FMP 4.1.

Effects on Management and Enforcement

By prohibiting the harvest of groundfish until fisheries could be certified, this FMP scenario would effectively suspend the need for management and enforcement of groundfish fishing activities. The NPFMC and NOAA Fisheries would still need to manage other fisheries in the EEZ and conduct needed research. This scenario would prevail until each Alaska groundfish fishery was subjected to an environmental review and, based on the results of that review, permitted to operate under strict guidelines. The review and certification process could take several years to accomplish, and could include a wide range of enforcement requirements. As fisheries become certified, a management and enforcement program would be reinitiated.

7.0 Data Gaps and Information Needs

As stated under Alternative 1, specific impacts to habitat from different management regimes are difficult to predict. Detailed information on the distribution and abundance of habitat types, the life history of living substrates, and the natural disturbance regime is generally incomplete for Alaskan waters. It is also unclear at present how fishing affects different habitat types under a variety of circumstances. Therefore, this qualitative analysis has assumed that greater habitat disturbance is expected with less habitat protection.

With respect to groundfish fisheries prosecuted with bottom trawl gear, bycatch, unobserved damage to living structures, and alteration of non-living structures have been attributed to the bottom trawl groundfish fishery through direct observation, local research, or as a result of scientific studies conducted outside Alaska. However, information is not available to determine whether or not this mortality constitutes significant damage to EFH or HAPC in the waters off Alaska. This should be the subject of future research. It is not known how such damage to EFH and/or removals of HAPC affect the productivity of groundfish species; this requires detailed knowledge of the role that benthic organisms play in life histories of target species and the ecosystem. Such information is not available and not easily determined, particularly in a marine environment such as the BSAI and GOA.

Additional research on all gear types and their effects on local marine habitat is needed to develop predictions that link gear type and effort to bottom disturbance, fish production, and recovery times in particular habitats (NRC 2002). For example, the forces that injure and dislodge a range of benthic organisms should be identified and a determination of the relationship between fish production and bottom disturbance is needed. This information could be used to develop fishing gear that is less damaging to habitat, helps to meet other conservation goals such as reduction of bycatch and maintenance of biological communities, is economical to the fleet, and reduces the incidence of derelict fishing gears.

Evaluation of the indirect effects of bottom trawling is needed (NRC 2002). The evaluation should include studying the effects of habitat fragmentation on biological communities and the resulting productivity of fish stocks; determining rates and magnitude of sediment resuspension during trawling and the response of the plankton community to the resultant nutrient regeneration; and obtaining long-term trend data on benthic production versus fisheries production.

The introduction to this qualitative assessment describes the Final Rule implementing the EFH provisions of the MSA (50 CFR Part 600), and includes a discussion of four levels of data that are necessary to describe EFH. At present for the BSAI and GOA fisheries, it is unlikely that data above Level 2 is available for a given species at a particular life history stage. In fact, for most BSAI and GOA species, only Level 1 data is available. Since the MSA mandates that Councils strive to obtain Level 4 data to describe EFH, the lack of higher level data in the groundfish fisheries is an identified, and potentially large data gap. (The data gap will be addressed in greater detail in the EFH EIS presently being prepared by NOAA Fisheries.)

An expanded research program that would seek to improve our understanding of marine habitat and its role in the health of the ecosystem is an integral component of the existing management regime (Alternative 1). Under policy Alternative 2, where we presume that commercial fisheries have no adverse environmental effects, this research program would be abandoned. Policy Alternatives 3 or 4 would place increasing priority for this research and in the case of Alternative 4, fisheries would be suspended until the information is available.

8.0 Comparative Analysis of the Alternatives

Table 10 and Figure 15 provide a comparison of the amount of area closed under each FMP scenario. As shown in Table 10 and Figure 15, all FMP scenarios with the exception of FMP 2.1 provide for 20 percent or more of the total fishable area (e.g., continental shelf and slope out to the 1000 m water depth) to be closed to bottom trawling for at least a portion of the year. However, the majority of the closure areas illustrated under the Alternative 1 FMP and under FMPs 2.2, 3.1, and 3.2 are not necessarily year-round, do not affect all gear types, nor do they focus on EFH. Therefore, these closures may not encompass the most sensitive habitat types and may not provide adequate protection of all life history stages of EFH species. In the case of Alternative 1 and FMPs 2.2 and 3.1, the total area proposed as no-take marine reserves on a year-round basis is less than 1 percent. With the exception of the Sitka Pinnacles closure area in Alternative 1 and FMPs 2.2 and 3.1, the no transit zones identified under the Steller sea lion protection measures are the only year-round, no-take areas designated under these alternatives.

Table 10 Percent of fishable area closed under Alternative 1 and FMP scenarios

	Alt. 1	FMP 2.1	FMP 2.2	FMP 3.1	FMP 3.2	FMP 4.1	FMP 4.2
Aleutian Islands							
No Trawl MPA	41.1%	41.1%	41.1%	41.1%	35.1%	15.0%	100%
No Take Marine Res	1.6%	1.6%	1.6%	1.6%	19.1%	69.6%	100%
No SSL HL Pot Trawl MPA	n/a	n/a	n/a	n/a	18.4%	n/a	100%
No SSL Trawl MPA	n/a	n/a	n/a	n/a	7.3%	n/a	100%
Total	42.7%	42.7%	42.7%	42.7%	79.9%	84.6%	100%
Bering Sea							
No Trawl MPA	19.2%	7.5%	19.2%	19.2%	21.3%	14.5%	100%
No Take Marine Res	0.1%	0.1%	0.1%	0.1%	4.3%	24.9%	100%
No SSL HL Pot Trawl MPA	n/a	n/a	n/a	n/a	5.3%	n/a	100%
No SSL Trawl MPA	n/a	n/a	n/a	n/a	1.8%	n/a	100%
Total	19.3%	7.6%	19.3%	19.3%	32.6%	33.5%	100%
Entire BS & AI							
No Trawl MPA	21.8%	11.4%	21.8%	21.8%	22.9%	14.6%	100%
No Take Marine Res	0.2%	0.2%	0.2%	0.2%	6.0%	24.9%	100%
No SSL HL Pot Trawl MPA	n/a	n/a	n/a	n/a	7.0%	n/a	100%
No SSL Trawl MPA	n/a	n/a	n/a	n/a	6.8%	n/a	100%
Total	22.0%	11.7%	22.0%	22.0%	38.1%	39.4%	100%
Central \ Western Gulf							
No Trawl MPA	33.1%	29.1%	33.1%	33.1%	31.0%	35.4%	100%
No Take Marine Res	0.5%	0.5%	0.5%	0.5%	16.6%	43.0%	100%
No SSL HL Pot Trawl MPA	n/a	n/a	n/a	n/a	5.1%	n/a	100%
No SSL Trawl MPA	n/a	n/a	n/a	n/a	13.0%	n/a	100%
Total	33.6%	29.6%	33.6%	33.6%	65.6%	78.3%	100%
Eastern Gulf							
No Trawl MPA	81.7%	0.0%	81.7%	81.7%	16.7%	65.5%	100%
No Take Marine Res	0.0%	0.0%	0.0%	0.0%	5.3%	21.9%	100%
No SSL H&I Pot Trawl	n/a	0.0%	n/a	n/a	70.3%	n/a	100%
Total	90.1%	0.0%	90.1%	90.1%	92.2%	87.3%	100%
Entire Gulf of Alaska							
No Trawl MPA	45.4%	21.7%	45.4%	45.4%	27.3%	43.0%	100%
No Take Marine Res	0.5%	0.5%	0.5%	0.5%	13.7%	37.6%	100%
No SSL HL Pot Trawl MPA	n/a	n/a	n/a	n/a	21.7%	n/a	100%
No SSL Trawl MPA	n/a	n/a	n/a	n/a	9.7%	n/a	100%
Total	45.8%	22.1%	45.8%	45.8%	72.4%	80.6%	100%
Total No Take Marine Reserves	0.3%	0.3%	0.3%	0.3%	8.2%	28.5%	100%
Total All Closures	28.8%	14.6%	28.8%	28.8%	47.8%	51.1%	100%

n/a - not applicable

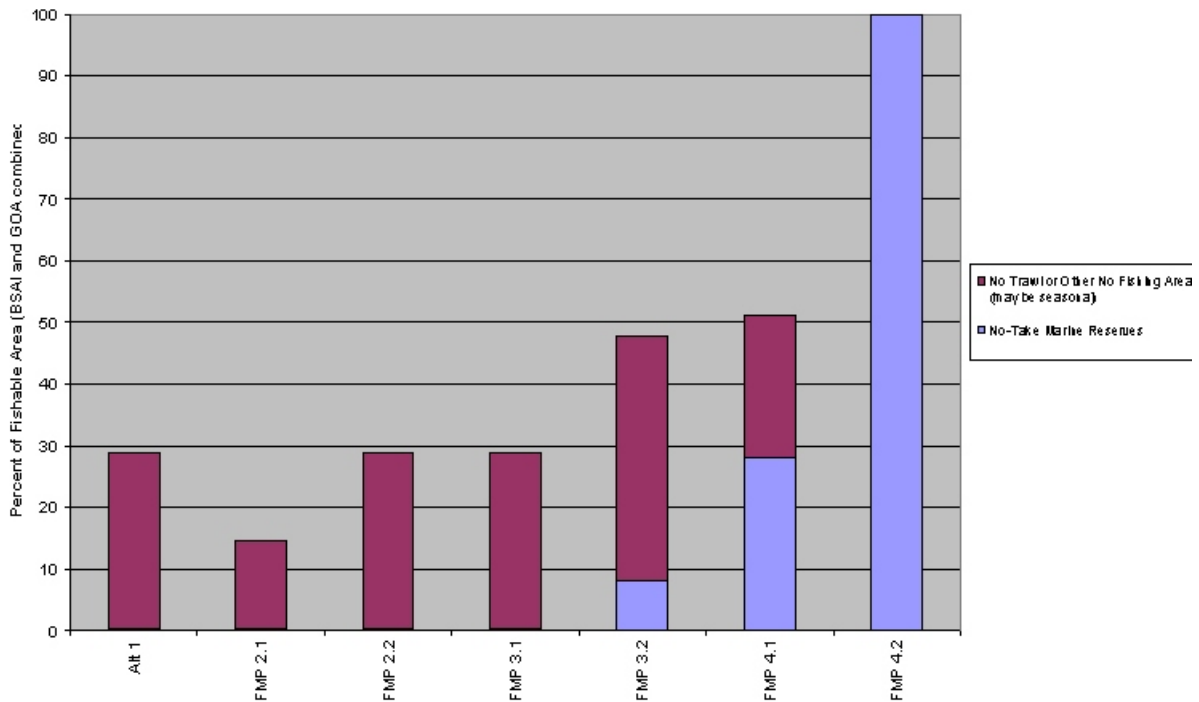


Figure 15. Comparison of closure area percentages by FMP scenario

FMP scenarios 3.2 and 4.1 close similar amounts of area (about 48 percent and 51 percent, respectively), but a larger percentage of the total area closed under FMP 4.1 is designated as no-take marine reserves and covers a broader range of habitat types. However, FMP 3.2, as illustrated here, exceeds the 0 to 20 percent rule for establishing MPAs because the suite of closures under this illustration attempts to optimize a number of FMP components (e.g., Steller sea lion Protection Measures, EFH protection). The Alternative 3 policy framework suggests an upper end range of closures at 5 percent of the fishable area as no-take marine reserves, with 20 percent being no-trawl MPAs. As shown in Table 10 and Figure 15, FMP 3.2 would close over 8 percent of the fishable area to all fishing and would designate nearly 50 percent of the fishable area as no-trawl MPAs. Protecting the marine environment through a system of MPAs and no-take reserves could have significant adverse effects on fishing communities, the fishing industry, and the economic health of the nation. Extensive care is needed in selecting candidate areas, and public input is critical.

The FMP 4.1 bookend also meets the recommended framework policy for Alternative 4. The bookend suggests 20 to 50 percent of the management area be designated as no-take marine reserves covering a full range of habitats. As shown in Table 10 and Figure 15, the scenario proposes to designate nearly 30 percent of the fishable area as no-take reserves with all closures totaling 51 percent. As discussed earlier, the concept of closures changes under this scenario. Previously, areas were considered open to all fishing until closed due to realized or perceived impacts. This alternative closes the GOA and BSAI and proposes that all areas be considered closed to fishing unless it can be shown that impacts from fishing would not be adverse. As shown on Figure 13, FMP 4.1 closes vast areas to all fishing (no-take marine reserves). However, many coastal areas would be open to commercial fishing other than trawl. These closures could cause economic hardships as trawl fishermen either have to go further from the community to fish, or have

to switch to another type of gear. The economic effects of this illustration are likely to be significant to the participants and to the communities.

The FMP 4.2 bookend essentially closes all areas of the EEZ to fishing until such time that impacts can be shown to be negligible. At that time, NOAA Fisheries would certify individual fisheries for operation in the EEZ under fishery-specific regulations. The actual mechanics of a certification process are unknown, and any process and subsequent regulation could take more than a couple of years to implement. Economic hardships associated under the scenario would be severe. While impacts on benthic EFH and HAPC would no longer occur, such benefits may be short-lived depending on which fisheries are subsequently permitted. It is not possible to predict these effects at this time.

9.0 Summary Comparison of All Alternatives

The following section summarizes the effects of each policy alternative with regard to EFH and MPAs, as determined through the analysis of the FMP framework bookends presented in previous sections. Table 11 summarizes the potential effects of each policy alternative bookend. A discussion of the policy level effects follows:

Alternative 1: Under this policy alternative, the NPFMC would continue to manage the groundfish fisheries based upon the present conservative and risk-averse policy. While new effects are not expected, existing beneficial and/or adverse effects could continue as indicated in Table 11. Since the areas closed under the current FMPs may not protect the full range of habitat types, are not necessarily year-round, do not necessarily prohibit the use of fixed gear, and do not incorporate concurrent reductions in TAC, there is a potential for adverse effects on EFH (both due to fishing induced changes in benthic biodiversity and HAPC). The closures could possibly benefit target and non-target species and since, for the most part, they are designed to protect prohibited species and Steller sea lions, prohibited species and marine mammals would benefit. As compared to a much more aggressive strategy, adverse and potentially adverse effects could be observed by catcher vessels, catcher processors, inshore processors, and consumers, while non-consumptive uses and non-use values would benefit.

Alternative 2: A more aggressive harvest policy would be implemented based upon the concept that the present policy is overly conservative and that higher harvests could be taken without threat of overfishing the target groundfish stocks. The identification of EFH, determination of appropriate habitat protection measures, and evaluation of candidate areas for MPAs would also continue, but certain areas presently closed to fishing in order to protect habitat could be considered open to fishing. Measures chosen to implement this policy could range from opening all areas presently closed (except those areas mandated as Steller sea lion Protection Measures) to maintaining existing closures under the current FMPs. As shown in Table 11, depending on the extent of the measures, all aspects of the physical and biological environments could realize adverse effects under this policy alternative. Again, depending on the extent of measures chosen to enact this policy, effects on the economic environment could be beneficial, while non-consumptive and non-use values would be negatively impacted.

Alternative 3: This policy would seek to accelerate the existing precautionary management measures through community or rights-based management, ecosystem-based management principles, and, where appropriate and practicable, increase habitat protection and impose additional bycatch constraints. Specifically, Alternative 3 seeks to reduce and avoid impacts to habitat by developing goals, objectives, and criteria to evaluate the efficacy of MPAs and no-take marine reserves as tools to maintain abundance, diversity, and productivity of marine organisms. Measures chosen to enact the Alternative 3 policy range from maintaining the existing closures under the current FMPs to designating 20 percent of the BSAI and GOA as no-trawl MPAs and no-take marine reserves (e.g., 5 percent = no-take, 15 percent = no-trawl MPA) across a range of habitat types. As shown in Table 11, the higher range of closures would have beneficial or possibly beneficial effects on all aspects of the physical and biological environments and on the non-consumptive and non-use values. Conversely, the designation of extensive closure areas would have potentially adverse or adverse effects on the economic sectors and communities.

Alternative 4: This policy shifts the burden of proof from the resources to the user and would require that the agency certify that the intended fishery would not have a detrimental effect on the environment before significant fishing could be permitted. Under this policy alternative, impacts to habitat would be reduced and avoided through zoning and limiting fishing gear use to the action area and establishing no-take marine reserves (both pelagic and nearshore) encompassing 20-50 percent of management areas. In fisheries that can be prosecuted with more selective gear, trawling would be prohibited and trawl closure areas would be established. As shown in Table 11, management measures under Alternative 4 would provide possibly beneficial effects to all aspects of the physical and biological environments and non-consumptive and non-use values, while impacts on the social and economic environment would be severely adverse.

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